Mt. Baker-Stillaguamish National Forest
Specialist Report
Environmental Assessment

South Fork Stillaguamish Vegetation Project
Hydrology
/s/Christopher Stewart
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1. Proposed Action used in this Analysis

Purpose and Need for Action

The overall goal is to manage forest stands in the South Fork (SF) Stillaguamish River drainage to promote forest stand structure that would serve as habitat for old-growth associated species and maintain and enhance Riparian Reserve conditions. Management would enhance the development of a resilient landscape for climate change which provides suitable habitat conditions for old-growth associated species and meets Aquatic Conservation Strategy objectives.

Need for the Project

1. **There is a need for more area with desired late successional habitat to provide nesting and other habitat characteristics for marbled murrelet and northern spotted owls**. The South Fork Lower Stillaguamish River and Canyon Creek Watershed Analysis (USDA Forest Service, 1996) (USDA Forest Service, 1995) pp. 5-31 identified terrestrial management recommendations in Table 5-2, pp 5-31 that include management of Late Successional Reserves to enhance recruitment of suitable nesting habitat for spotted owl and marbled murrelet.
2. **There is a need for restoration of plantations within Riparian Reserves to restore species composition and structural diversity to support well-distributed populations of native plant, invertebrate and vertebrate riparian associated species.** The goals for aquatic systems as described in the Mt. Baker-Stillaguamish Land and Resource Management Plan (USDA Forest Service, 1990), as amended by the Northwest Forest Plan (USDA Forest Service and USDI Bureau of Land Management, 1994) (ROD p. B-11).
3. **There is a need for a restoration of this landscape to a condition that would be resilient to major disturbances such as climate change and to provide and protect habitat for native species and species of concern**. The Climate Change Vulnerability and Adaptation in the North Cascades Region, Washington assessment provides adaptation strategies for restoring previously harvested stands in order to promote resilience to climate change. Recommendations are focused on restoring habitat, ecological processes and managing for changing disturbance regimes. The climate change vulnerability assessment builds upon the National Roadmap for

Responding to Climate Change and subsequent USDA Strategic Plan for FY 2010-2015.

4. **There is an opportunity to begin implementation of recommendations in the Forest's Sustainable Road System Report.** The Mt. Baker-Stillaguamish National Forest has completed the report for management of a sustainable road system across the forest. This report was a requirement of the 2005 Travel Management Rule (36 CFR 212.5(b)(1)). A sustainable roads analysis is intended to identify opportunities for the National Forest transportation system to meet current and future management objectives, and to provide information that allows integration of ecological, social, and economic concerns into future decisions.

Purpose of the Project

1. Within the SF Stillaguamish Vegetation Project Area, the purpose of the project in Late-Successional Reserves is to enhance habitat conditions for old forest associated species with emphasis on nesting habitat for marbled murrelet and northern spotted owls (USDA Forest Service and USDI Bureau of Land Management, 1994) (ROD p. A-4). Of particular interest are the structural components of large limbs for murrelet nesting platforms and large trees with cavities for nesting spotted owls (USDA Forest Service and USDI Bureau of Land Management, 1994) (p. B-5).
2. The purpose of the project in Riparian Reserve areas is to restore tree species composition and structural diversity (USDA Forest Service and USDI Bureau of Land Management, 1994) (ROD p. B-11), with emphasis on the amount and species of large diameter trees for future down wood recruitment, and to enhance habitat (especially understory habitat) to support well-distributed populations of riparian-dependent species.
3. The purpose is to continue to monitor the implementation and effectiveness of management approaches and techniques in Late Successional Reserve management.
4. The purpose of the project is to manage the SF Stillaguamish Late Successional Reserve on a landscape scale with opportunities for forest management actions identified for the next 10 to 20 years. The expectation is that vegetation management may also contribute a supply of timber products to the public from the forest stand thinning. The forest stand treatments would produce merchantable timber as a product of necessary and desirable restoration actions. Proposed actions would be focused within forested stands 20-80 years of age.

Alternative 1 – No Action

The No Action Alternative, as provided by the Council on Environmental Quality (CEQ) National Environmental Policy Act (NEPA) regulations (40 CFR 1502.14), serves as a baseline to compare impacts of the action alternatives. Under the No Action Alternative, the proposed SF Stillaguamish Vegetation project would not occur, and current management plans would continue to guide management of the project area. Existing processes and trends within the project area would continue for the time being.

Alternative 2 – Proposed Action

Alternative 2 is the Proposed Action. The Proposed Action consists of forest stand management and connected ground-disturbing actions, road management actions, aquatic restoration actions and recreation management activities that implement the purpose and need of the SF Stillaguamish Project. Thinning treatments would be applied to a portion of the stands within a 65,000 acre project area. Road management maintenance levels would be changed to better align the road system maintenance with projected uses, and remove existing fish migration barriers to improve aquatic organism passage. Recreation sites in proximity to stand treatment areas would be upgraded to better meet needs identified at existing trailheads and travel routes.

Figure 1: Proposed Action

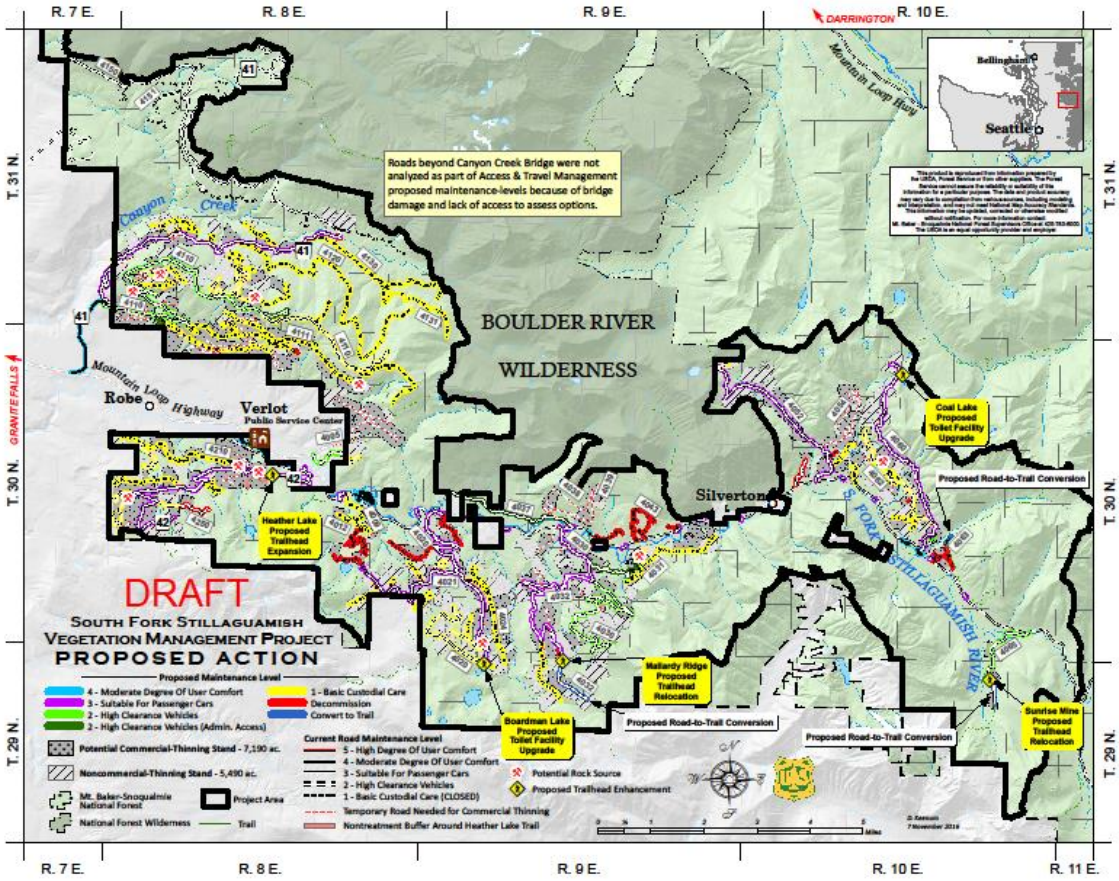


Figure 1 is a map of the Proposed Action showing the proposed stands for treatments, the proposed road maintenance levels, proposed fish passage improvements, and recreation site changes.

The proposed action includes the following components:

- **Forest Vegetation Management**
  - Non-commercial thinning of densely stocked stands (walk-in, cut and leave downed trees)
  - Commercial thinning of stands by removal of timber with the connected actions necessary for stand treatments

- **Other Actions within the Project Area**
    - Access management with road treatments (upgrades, storage, and decommissioning).
    - Trail, trailhead and visual quality management.
    - Aquatic organism passage improvements

Forest Stand Treatment - Non-commercial Thinning

Non-commercial thinning is the cutting of trees that are limiting growth and development of the forest stand, but are not large enough to produce harvested materials with commercial value. There are approximately 4800 to 5700 acres that would benefit from spacing of residual trees in non-commercial thinning where trees would be cut and left on-site. The total amount of acres treated would be determined by the funds generated by the commercial thinning in the project as well as other funding sources in future years.

Noncommercial stands are displayed in Figure 1 (proposed action)

Forest Stand Treatment - Commercial Thinning

While there are up to 7200 acres of second-growth stands within 0.5 mile of an open road that have potential for commercial thinning, not all of those acres would have thinning treatments. The total acres treated would be determined during layout of the thinning units with the following areas excluded from commercial thinning activities:

- no-cut buffers on fish-bearing, perennial and intermittent streams
- wetland and unstable soil areas
- areas of potential marbled murrelet nest trees,
- areas dropped due to logging feasibility constraints and
- areas dropped due to uneconomical road reconstruction costs.

A range of approximately 30 to 50 percent (2160 to 3600 acres) of the potentially commercial stands would have ground-disturbance activities from proposed thinning based on the resource exclusions listed above as well as mitigations and best management practices in Section 2, with the resources considerations highlighted below.

Commercial Thinning - Hydrological Considerations

All perennial non-fish bearing streams would have a minimum of 30 feet of protection from harvest equipment and tree cutting. Ponds, wetlands, seeps and springs would also have at least 30 feet of protection, as well as unstable soil areas. Fish-bearing streams would be protected for at least 100 feet, including those streams designated as critical habitat for Puget Sound Bull Trout, steelhead, and Chinook salmon. Fish barriers to aquatic organism passage would be removed or replaced to promote aquatic habitat connectivity throughout the project area.

Commercial Thinning – Wildlife Considerations

The project would design the thinning to promote murrelet and owl nest structure, provide habitat connectivity and improve diversity of songbird habitat in riparian areas. In meeting the purpose and need for the project, the project would:

- Not cut trees greater than 20 inches DBH (LSR guideline)
- Retain second growth suitable nesting structure within treated stands
- Protect raptor nests with no action buffers

Commercial Thinning – Recreation Considerations

The project area overlaps with a high-use recreation area and a scenic by-way route with Forest visual quality objectives. The project design and mitigation measures would minimize impacts of project implementation on recreation and visual quality where and when feasible. The project would:

- Meet visual management objectives along the Mt. Loop Scenic By-way and routes to major trailheads with variable density thinning and buffers on trails.
- Provide no-cut buffers on Heather Lake and Perry Creek Trail
- Relocate the Sunrise Mine and Walt Bailey (Mallardy Ridge) trailheads back to a location that would provide better parking opportunities than current road-end parking. Convert abandoned road sections to trail with a hydrologically stable route
- Minimize the duration of impacts to recreational access by limiting the number of trails closed at a given time, implementing complete road closures to shorten project duration or time needed to complete thinning activities, and minimize road and trail closures on week-ends and holidays.
- Upgrade roads, hiking trails and trailheads to reduce sediment contributions to the watershed, and provide safe recreation opportunities.

Commercial Thinning – Treatment Description

Commercial thinning would be applied on up to 3600 acres. In this project the treated Riparian Reserve areas would not receive a different prescription than upland Late Successional Reserve slopes due to the similarity in the thinning objectives for desired forest vegetation and structure. All treated acres would emphasize forest stand development and enhancement of old forest characteristics, including species and structural diversity, and recruitment of coarse woody debris. The thinning description would provide the following:

1. Stands would be thinned to target relative density 35 (RD = BA/(QMD^1/2) using a variable density thin from below, incorporating irregular spacing and clumps of residual trees, as an intermediate treatment (not stand regeneration). The thinning would remove primarily smaller trees to allocate additional growing space to remaining larger trees. Thinning would generally remove trees of the most abundant conifer species, while leaving less abundant conifer species and hardwood species in the stand. Minor species would be favored for retention. The residual trees would generally be dominant or co-dominant, and may include trees with damage or defects such as root rot, multiple tops, spike tops, bear damage, and dwarf mistletoe that contribute to structural complexity within the stand and have potential to develop future snags, nesting cavities, and nesting platforms.

2. Heavy thinning areas would be used to emphasize large tree growing space and increase understory vegetation. Thinning would be from below to approximately 20-50 trees per acre, retaining hardwoods and minor conifer species. Heavy thinning areas would be approximately ½ acre to 3 acres in size and cover approximately 3-10 percent of the stand area. Heavy thinning would only be prescribed in stands with low windthrow potential.

3. Gaps would be created to increase stand heterogeneity, and culture individual trees specifically for big crowns and limbs. All conifers larger than the minimum diameter limit and less than 20 inches DBH would be removed from gaps, while all hardwoods would be retained. Gaps be approximately ¼ to ½ acre in size and cover 3-10% of the total stand area and avoid be located immediately adjacent to old growth forest or potential nest trees.

4. Skipped areas would retain uncut, densely stocked areas in at least 10 percent of the stand area. Areas within stands proposed for treatment that would be left un-thinned include riparian no-cut buffers, hardwood and minor species areas, plant protection buffers, and areas otherwise unsuitable for commercial thinning. Additional skips may be designed as needed in stands that lack these features.

5. Trees greater than 20 inches DBH would not be cut. Any trees greater than 20 inches DBH that are required to be cut for safety or operational reasons, such as temporary road building, landing clearing, or log yarding, would remain on site as coarse woody debris.

6. Retain all snags and large downed wood. Snags and downed wood contribute to structural complexity and would be retained on site, undisturbed if possible with consideration for safe operational requirements. Any snags felled for safety reasons would be left on site.

7. Leave trees would be selected irrespective of whether the tree has any damage, so that trees with defects, potential cavity or nesting trees and other similar features of structural diversity may be retained in the units. In this case, the term "damage" refers to breakage, double tops, crooks, heart rots, ants, etc., that cause loss of wood volume, but usually won't kill the tree. Trees with fading crowns or bleeding boles indicative of root disease that may infect neighboring trees and create snags and coarse woody debris over time would be favored for retention.

8. Cedar and hardwoods: Western redcedar would be retained in stands where it is not currently well represented in species composition. Thinning in dense stocked cedar areas would occur in order to release cedar from competition. All Pacific yew within the stands would be retained. Alders and other hardwoods representation within the stands would be retained for mollusk and neo-tropical migrant bird habitat.

9. Leave Tree Protection: Limit skyline corridors to 15 to 20 feet in width where possible and include guy trees as part of the thinning prescription to reduce impact to residual stand (that is, if a guy tree is the largest tree in its vicinity and would

otherwise be the "leave-tree", substitute the next largest tree as the "leave tree"). Tail trees that are damaged during operations would be retained and contribute to snags or coarse woody debris on site.

10. Potential Nest Tree protection: Marbled murrelet potential nest trees and old-growth legacy trees would be protected with retention of the adjacent tree(s) with interlaced or interlocked branches (typically 20 ft. radius). Potential nest trees are defined as having the features listed below:

    - Branch structure (or mistletoe broom) providing horizontal platform(s) ≥ 4 inches wide, 33 feet above ground or higher.

11. Coarse woody debris: Coarse woody debris (CWD), dead and down wood on the forest floor, existing on the site prior to thinning and exceeding 21 inches in diameter may be moved for access, but would not be removed from the site. Disturbance of existing CWD exceeding 21 inches in diameter would be minimized to conserve CWD in the stands proposed for treatment. Temporary roads and skid trails would be closed after logging. Big, old stumps would be kept intact and not uprooted wherever possible.

12. Snag protection: Any legacy snags found in the stands would be buffered with a no-cut buffer radius equal to or greater than the height of the snag to protect forest workers and keep snags on site. In addition, all other snags with would be retained unless they pose a hazard to human safety. Where possible, skips would be placed in locations that incorporate snags.

13. Soil Protection: Where cable harvesting systems are used logs will be yarded with either full or single-end suspension. Where cable corridors cross no-cut riparian buffers, full suspension will be maintained. Any trees felled for corridors within riparian no-cut buffers will be left on the ground. Cable corridors should be kept away from snags when possible. Where ground-based logging systems are used felling will be accomplished in a single pass of equipment. Skid roads will be approved by the sale administrator and equipment will travel on operationally generated slash as much as possible to minimized soil disturbance and compaction. Skid roads and trails will be spaced as widely as possible. Existing skid roads and trails should be used where possible.

Logging Systems: Thinning treatments would be accomplished with both ground based equipment and cable harvesting systems. The current assessment is that approximately 35 percent of the forest stands have terrain that would facilitate traditional ground based equipment operations on slopes of less than 35 percent. Recent innovation in equipment is providing options for use of tethered equipment on slopes of up to 50 percent. Use of ground base equipment or tethered equipment decreases worker exposure to logging operations and is currently being explored in the region.

Forest Stand Treatment - Connected Actions

The proposed action would include the following connected actions associated with the timber harvest described above. These connected actions include the best management practices and mitigations described in Section 2.2

Roads. To facilitate the commercial thinning, the Proposed Action would require use of both open and closed Forest System roads.

- Use of 57 miles of open Forest System roads. Actions associated with use of these roads would be normal routine road maintenance on all the miles with spot reconstruction. Timber purchasers would be required to perform road repair and maintenance work as a condition of timber-sale contracts prior to using the roads. Road maintenance and repair would include rock resurfacing, blading and shaping road surfaces, roadside brushing and cleaning drainage structures.
- Reopening 29 miles of now-closed Forest System roads, and closing them after use. Reopening or reconstruction of roads may include fill repairs, culvert replacements, asphalt repair, road re-surfacing and bridge repairs with a variety of repairs from rock-surfacing, ditch clearing, should repairs to drainage improvements anticipated. Temporarily opened stored roads would be hydrologically treated, waterbarred and closed through the timber sale contract after harvesting activities.
- Daylighting of the road prisms would be for safe passage of heavy equipment and reduction of tree debris fall that could plug or redirect drainage flows resulting in road erosion and impacts to streams. This would remove primarily the overhanging hardwoods within 30 ft. of the road edge and the removal of hazard trees (both conifer and hardwoods) up to 50 ft. from the road edge that are leaning into the road prism or otherwise posing a threat to safe use of the road prism.

Temporary Roads. To facilitate harvesting of stands away from open roads, the project would open or re-open on a temporary basis a number of unspecified or non-system road segments (14 miles) as well as use of road prisms from previously constructed temporary roads (23.4 miles) and 1.8 miles of new road for a total of approximately 40 miles of temporary roads . The use of old system roads and temporary roads previously used in past timber harvest would limit the need to construct new temporary roads, and limit the amount of new temporary road to 1.5 miles. The proposed action would remove residual culverts in temporary roads and reconfigure drainage problems where old roads have intercepted or redirected flows.

- Reconstruction of 14 miles of unspecified Forest System roads and reconstruction of 23.4 miles of former temporary roads, closing them after use. Work includes reestablishing a safe road prism, road re-surfacing with drainage improvements. Temporarily opened roads would be hydrologically treated, waterbarred and closed after harvesting activities.
- Construction of 1.8 miles of new temporary roads with decommissioning of the roads following thinning activities.

Rock Sources. To facilitate haul on system and temporary roads, some road surface rock would be required. Some of the surface rock for these roads may be supplied from commercial sources. However, rock also would be extracted and used from existing rock pits (**Figure 1**) and one new site, all located on National Forest System (NFS) lands:

- Blackjack (Rd 4031-015)- existing
- Boardman (Road 4020) - existing
- Pilchuck (Road 4240) - existing
- Green Mountain- four existing sites
  - Road 4111,
  - Road 4110-024,
  - Road 4113-012 and
  - Road 4110 second switchback at junction with temporary road
- Beaver Creek (Rd 4062-030) - existing
- Lower Pilchuck (Road 42 at MP1.6) - existing
- Road 4210, at MP 0.8 - new rock site development

Water Sources. To facilitate road construction and maintenance as well as fire protection, water may be needed. Water drafting sites would be identified during project implementation. Water removal would be primarily along the main stem of the S.F. Stillaguamish and major tributaries at sites designated as per best management practices in Section 2.

Fuels Treatment

- Activity fuels within stands would not be treated due to fuel loading would not exceed Forest Plan objectives
- Slash at landings and along roads that remain open to the public post treatment would be disposed of by 1) piling and burning, 2) chipping and dispersal, 3) fire wood permits or 4) a combination of these methods.

Activity fuels within the stands would not be treated. At the project scale, activity fuels created within the units as a result of timber harvest would not create activity fuel loadings that exceed Forest Plan objectives.

Whole-tree yarding would have mitigations to prevent large accumulations of slash at log landings. Slash that does accumulate at landings would be disposed of. Disposal consists of (1) redistribution of slash in the unit (2) piling and burning at the landing according to normal stipulations that protect air quality and standing live timber, (3) chipping and spreading to a depth of no more than 4 inches, or (4) some combination of the above methods.

Slash fuels would be pulled away from the area around landings that occur on or adjacent to Roads. The slash would be pulled to the landing and disposed of with other landing slash. Fuels would be pulled from within 150 feet uphill of these landings and from within 50 feet below or on flat ground adjacent to these landings.

Other Vegetation Management

- Treat invasive plants throughout the project area as per the direction in the ROD for the MBS Invasive Plant FEIS (2015).
- Revegetate areas of bare soil where designated (best management practices)

Other Proposed Actions within the Project Area

Recreation Site Improvements

The proposed action includes improving the condition of recreation sites and amenities in key recreation sites throughout the project area. Many recreation sites along the Mountain Loop Scenic Byway have outdated toilets, and do not have safe parking or sufficient parking capacity for the level of use.

Heather Lake Trailhead Expansion

The Heather Lake parking lot which currently has space for roughly 25 vehicles is filled to capacity on most weekends and holidays throughout the year causing visitors to park along both sides of the road which constricts traffic going to Mt. Pilchuck Trailhead and causes safety concerns for pedestrians walking along the roadside. Over 100 cars have been counted parked at the trailhead and along the road. This trail is one of the most heavily used on the Darrington Ranger District and provides access through magnificent old-growth forest to a beautiful alpine lake which is also enjoyed during the winter as a popular snowshoeing and other snow activities destination. Volunteer groups constructed the bottom ½ mile of the trail in the early 1990's and continue to maintain it. The parking lot would be expanded from approximately 25 parking slots to 75 by removing 1 acre of vegetation on the north side of the parking lot perimeter. Brush, rocks and most trees within the 1 acre footprint would be removed. Wheel stops would be installed in the new parking slots. The total area of new disturbance would be approximately 1 acre. The current ROS designation for the existing parking area is 1D Roaded Natural which allows for expansion by Forest Plan standards. There would be no change or effects to ROS standards with this improvement.

Sunrise Mine Trailhead Relocation and Expansion

Similar to Heather Lake, this popular destination is often overcrowded causing visitors to park along both sides of an already narrow Forest road causing unsafe conditions for drivers driving on both sides of the road during the busy summer season. The proposal is to relocate the Sunrise Mine Trailhead back to a flat ridge approximately ½ mile north of the existing trailhead. The section of road between there and the current road end would be decommissioned and converted to trail following completion of stand treatments. The area surveyed offers the opportunity for an expanded and safer Sunrise Trailhead and picnic site that would enjoy one of the most spectacular view points available from a road on the MBS. Weekend car counts at the current trailhead exceed 100 vehicles at times. Parking space for approximately 75 cars would be provided for the trailhead and picnic site combined by removing approximately 1-2 acres of vegetation along the east and west sides of the existing road. Wheel stops would be installed in the new parking slots. The total area of new disturbance would be approximately 1-2 acres. The current ROS designation for the existing parking area is 1D Roaded Natural which allows for development of recreation facilities for the purpose of enhancing the recreation experience or protecting resources by Forest Plan standards. There would be no change or effects to ROS standards with this improvement.

Walt Bailey Trailhead Relocation and Expansion

Similar to Sunrise Mine, this trailhead would be relocated approximately 1 mile back along the road from its current location in a former log landing site. The section of road

between there and the current road end would be decommissioned and converted to trail following completion of stand treatments. Parking slots for approximately 30 vehicles will be provided by removing less than ¼ acre of vegetation within a total area of disturbance of approximately 1 acre. Wheel stops would be installed in the new parking slots. The current ROS designation for the existing parking area is 1D Roaded Natural which allows for expansion by Forest Plan standards. There would be no change or effects to ROS standards with this improvement

Aquatic Organism Passage Site Improvements

The proposed action includes improving the condition for aquatic organism passage in key sites throughout the project area. Culverts identified as barriers to fish migration within the project area would be replaced or removed as part of the proposed action alternative. The barriers that exist on proposed haul routes would be upgrades, while barriers that exist on closed roads would be removed. For both barrier treatments, the actions taken would be to simulate physical conditions found in the natural stream environment by designing channel dimensions, slope, and streambed structure so that water velocities and depths mimic natural hydrological conditions. Thus, the simulated channel would present no more of an obstacle to aquatic animals than the natural channel.

Implementation of the above would require ground disturbance, largely within the road prism at the fish barrier location, but may include 25 to 50 feet in all directions to re-establish channel profile and/or floodplain habitat. The use of heavy equipment may require removal of ground cover, understory vegetation, and trees within this area for safe operation and full channel restoration. All areas of ground disturbance would be mulched or re-planted with native vegetation. Typical fish passage projects could close roads completely or to one lane for up to eight weeks depending on the size of the project.

Access and Travel Management

This project provided an opportunity to begin assessment of recommendations in the Sustainable Road System Report (2015) for the road system within the project area of the SF of the Stillaguamish. The ID team reviewed the road system and the sustainable roads analysis to identify opportunities for the National Forest transportation system to meet current and future management objectives, and to allow for integration of ecological, social, and economic concerns into future decisions. The ID team reviewed what access is desired to treat stands with this project and in the future, where there are recreational and community use areas, what the current road maintenance levels are and current drivability of the road system. The ID team also reviewed what is in the Sustainable Roads Report (2015), and how the current road conditions align with the findings in the Sustainable Roads System Report. The road systems from the bridge on Road 41 in Canyon Creek and beyond were not assessed due to the lack of access, lack of knowledge of current conditions, and the complexity of the access issues which are to be addressed in a separate assessment. As part of the SF Stillaguamish Vegetation Project, Alternative 2 proposes to:

- Decommission approximately 14 miles of National Forest System road no longer needed for forest management (currently non-drivable)

- Store approximately 17 miles of National Forest System roads and retain approximately 56 miles of National Forest System road in closed status, Maintenance Level 1 for a total of 73 miles in ML1 (closed road status)
- Retain approximately 20 miles of National Forest System road in Maintenance Level 2 (high clearance vehicles)
- Retain approximately 7 miles of National Forest System road in administrative closed Maintenance Level 2a (gated roads)
- Retain approximately 53 miles of National Forest System road in Maintenance Level 3 (currently drivable – passenger comfort)
- Retain approximately 5.26 miles of National Forest System road in Maintenance Level 4 (currently drivable – passenger comfort)
- Convert approximately 1.7 mile of National Forest System road in to trail
- Retain 23.4 miles of former National Forest System Road (dropped from current system list in the Forest database) for use as temporary roads and treat for aquatic restoration needs.

Activities associated with the Proposed Road Maintenance Levels are described in table 2-X .

Table 2-x –Treatment options and ground disturbance associated with Road Maintenance Levels (ML)

Treatment Name and Description	Treatments by Maintenance Level		
	Decommissioned Roads ML0	Closed Roads ML1	Open Roads ML2-5
Passive Management - Road has not been used in recent past, vegetation has naturally overgrown the roadbed and natural drainage patterns are functioning at a high level. Appropriate on roads past active treatment areas.	X	X	
Active Entrance Treatment – gate, berm, or otherwise block entire width of roadway. Road is allowed to revegetate naturally, and drainage patterns are allowed to function as-is.	X-	X	
Active Treatment – gate, berm, or otherwise block entire width of roadway. Would also include additional treatments from the following list:	X	X	
Full Width Decompaction – complete disturbance (de-compaction) of the entire width of the roadway for up to 18" depth by mechanical construction equipment. (This includes commonly describe techniques such as "Pavement Ripping" where asphalt pavement exists.)	X		
Partial Area Decompaction (Craters) – localized, relatively small (approx. 3' x 3' wide) patterned de-compacted zones (known as "craters") established by mechanical construction equipment in the roadbed (aka moonscaping).	X		

Treatment Name and Description	Treatments by Maintenance Level		
	Decommissioned Roads ML0	Closed Roads ML1	Open Roads ML2-5
Minor Drainage Improvements – generally include the construction of water-bars, swales, rolling dips, and other water conveyance techniques to minimize localized erosion potential.	X	X	
Minor Fill Removal/Stabilization – generally involves localized removal of unstable fills and pulling back road shoulders in hill-side construction areas where cut/fill techniques were used to balance cuts and fills. The intent in this case is not to fully restore natural (pre-road construction) contours.	X	X	
Minor Culvert Removal – for both cross-drains and stream crossings generally involves removal of smaller diameter pipes (less than 36") and shallow fills (less than 10 ft), stabilization of adjacent slopes, re-establishment of natural drainage patterns.	X	X	
Major Culvert Removal – for both cross-drains and stream crossings generally involves removal of large diameter pipes (greater than 36") and deep fills (greater than 10 ft), stabilization of adjacent slopes, re-establishment of natural drainage patterns. Remove fill over large culverts and deep fills to dip drainage/reduce fill	X	X	
Re-contouring – generally involves complete elimination of the roadbed and re-establishing natural (pre-road construction) contours and slopes. This method is employed on hill-side construction areas where cut/fill techniques were used to balance cuts and fills during construction. The intent is to fully remove the entire presence of the roadbed.	X		
Bridge Removal – generally includes removal of all portions of a bridge structure including decking, asphalt paving, abutments and other appurtenances.	X		
Convert road to trail – activities could include laying back cut banks and moving that material to allow for recontouring the slope. Vegetation would be allowed to revegetate as much as possible to achieve a natural look. Trails would accommodate, use consistent with management area allocations, and Road to trails would accommodate the use designated for the trail which the road conversion would be a part of (Perry Creek, Sunrise Mine and Walt Bailey Trails are currently limited to hiker use only). Drainages would be designed for hand tool maintenance. (Stored roads remains on system as road, but can be used as trail)	X		
Active Maintenance (e.g., brushing, signing, culvert cleaning) would occur as appropriate and when needed. May also include:			X
Minor Drainage Improvements – generally include the construction of water-bars, swales, rolling dips, and other water conveyance techniques to minimize localized erosion potential.			X
Road stabilization – repair existing road failures – includes reconstruction of road, bridge and slope stabilization (e.g., H-Pile wall, wood placement in streams).			X
Stream crossing structures – would be replaced to meet current standards (e.g. meet 100 year flow and AOP) as funding is available.			X

Timing of Project Activities

Most activities would be completed within the next 10 to 15 years. Some actions related to timber sale preparation could begin at the earliest possible implementation date. Other actions, such as road to trail conversion would not begin until after thinning is completed. Connected actions may require sequencing over the 10 or more years with the commercial thinning activities which would occur over the course of several years. Road and trail maintenance activities, road decommissioning and aquatic organism passage activities, etc. would also occur intermittently, as funding becomes available through timber sales or other sources.

Alternatives 2A and 2B

Alternative 2A and 2B incorporate new information from field crews and respond to comments from the public and Tribes. Both Alternative 2A and 2B are very similar to Alternative 2 with minor changes in the stands proposed for thinning. Alternative 2A would drop some stands or portions of stands from commercial thinning treatment and non-commercial thinning. Alternative 2B would also drop both commercial and non-commercial thinning stands, but would also add other stands to meet purpose and need to enhance habitat conditions for old forest associated species and restore riparian conditions. The stands that would be dropped from non-commercial thinning in both Alternative 2A and 2B are due to these stands having advanced in development beyond the stage that would be most responsive to a non-commercial thinning treatment and are not large enough to produce harvested materials for commercial value. These stands would not be treated at this time, but would be considered "On-Hold" for thinning treatments at a later date to meet desired conditions in Late Successional and Riparian Reserve. Besides the changes in stand treatment areas, Alternatives 2A and 2B add to Heather Lake Trail buffer protection, clarify the operating work season, and display slight differences in road management and miles in Access and Travel Management between the alternatives.

Actions common to both Alternative 2A and 2B:

Heather Lake Trail Protection

Alternative 2A and 2B would provide additional visual management protection to the Heather Lake Trail. In Alternative 2A and 2B, there would be no thinning treatment upslope of the trail and the 100 foot buffer on the trail would be expanded with no thinning within the stand midslope from the road to the trail for a minimum 250 ft. to over 500 ft. trail buffer.

Work outside of Normal Operating Season

Alternative 2A and 2B retain the Normal Operating Season (NOS) from June 1 to October 15th as described in Table 5 (Draft EA) of Management Requirement and Mitigation Measures in Alternative 2. The Soil, Water and Fisheries mitigation #9 (SWF9) provides the following descriptions of operating seasons:

"All yarding and haul activities will be scheduled to a Normal Operating Season (NOS), defined as June 1 to October 15. During periods outside the NOS, yarding and haul operations may proceed with both: (1) notification of decision maker and aquatic specialists and (2) monitoring of weather and conditions to evaluate if wet weather logging operations meet project design elements and Management Requirements and Mitigation Measures.

Any yarding and haul activities occurring outside of the NOS defined as June 1 to October 15 will require monitoring of conditions as follows:

- Implementation and effectiveness monitoring of BMPs will be part of the wet weather haul agreement.
- Potentially damaging project activities will be curtailed and corrective action taken when situations develop such as: ponding, rutting, rilling, scour or sediment transport and deposition downstream of cross drains,
- Actions will be taken when adverse conditions are encountered on adjacent system roads, temporary roads, skid trails, landings, haul routes, stream crossings, riparian reserves or within harvest units where ground disturbance has occurred."

This mitigation would allow for potential yarding and haul outside of the NOS if appropriate conditions were met, but would preclude new road construction or road reconstruction work outside of the NOS. Work outside of the NOS could result in the need for additional erosion control measures (completed during NOS) such as surfacing with larger aggregate along roads and stream approaches, relief pipes, additions of surface water diversion (i.e. rubber strips), check dams and/or sediment traps and activating ditch lines. Road maintenance would be accomplished as needed to reduce road damage and potential resource impacts.

The option of working outside of the normal operating season would minimize impacts to the summer recreating public and maximize seasonal time that operators would be on site. This could reduce the number of seasons with ground disturbance at a site or the portions of the drainage being worked on at one time (a longer work season could also minimize mobilization times). Work outside of the normal operating season would proceed when weather and road conditions are such that soil, water and fisheries resource impacts can be minimized with conservation mitigations, and meet Aquatic Conservation Objectives.

Stands dropped from Alternative 2 non-commercial thinning

Alternative 2A and 2B would drop stands from proposed non-commercial thinning treatment. There were approximately 4800 to 5700 acres of second-growth stands identified with stocking levels that would benefit from spacing adjustments of residual trees. In Alternative 2A and 2B, the non-commercial stands were reviewed for those stands that would be most responsive to non-commercial thinning treatments. The younger stands (< 29 years of age) were considered to most likely respond to non-commercial thinning depending on stand elevation and site characteristics. In Alternative

2A and 2B, there are 1060 acres that are identified within a development stage most likely to respond to non-commercial thinning. There are approximately 4000 acres of second growth ranging from 30 to 45 years of age that would benefit from stocking adjustments, but have not been assessed as being large enough to produce harvestable material to support treatment through commercial thinning. In Alternative 2A and 2B these stands beyond optimal non-commercial treatment are identified as "On-hold" for future commercial thinning. These stands would not be treated at this time, but would be held for thinning treatments at a later date to meet desired conditions in Late Successional and Riparian Reserves.

Road System Used in Vegetation Treatment

Alternative 2A and Alternative 2B would use the haul routes for the thinning harvest as described in Alternative 2 with refinement of what temporary roads would be used. In both alternative 2A and 2B, the extent of reconstruction of former temporary roads and unspecified roads (28 miles in Alternative 2) would decrease with the construction of new temporary roads to increase. This adjustment in the temporary roads to be used (reconstruction or new) is a reflection of information gained in continued field reconnaissance and specialists' input. Some of the previously constructed temporary roads crossed drainages which can be avoided with new temporary road in more stable locations. When this situation arises in the layout, the project would select the temporary road location that would minimize impacts to resources (specifically aquatic resources). Both Alternative 2A and 2B would utilize a similar number of road miles for accessing the stands to be thinned, but would forego reconstruction of previous roads in some unstable stream crossing for new temporary road in more stable locations.

There is also the need for new temporary roads in stands that previously were harvested with taller towers resulting in a longer reach for the skyline corridor yarding of the harvested timber. Current logging systems utilize different equipment and do not have the longer yarding reach so temporary road would be constructed when needed as per the mitigation measure of Soils, Water, Fisheries (SWF) 28. This mitigation provides the following direction for: "If temporary roads, other than those identified and shown on the EA map are proposed for construction, they would be located within the EA stand boundaries and avoid sensitive sites such as shallow soils, unstable landforms, and wetlands; and would minimize disruption of natural hydrologic flow paths; including surface and subsurface flows. Upon addition or changes to the road system, consult the ID team to ensure effects of changes are within the effects analyzed in the EA."

Based on the information from additional field work in the Green Mountain area of the project, there would be an estimated 1 to 2 miles of new temporary road constructed within this portion of the project, depending on the logging system and extent of thinning within the stand, and a reduction in approximately 1 mile of previous used road. Using this information to extrapolate to other areas within the project, there is an estimated range of new temporary roads within the project area of 5 to 10 miles and a reduction in reconstruction of previous temporary roads that would be not be used. New road construction would be in the vicinity (sub-drainages) of the reconstructed temporary roads displayed in Alternative 2. All new temporary roads would be decommissioned following use.

Actions Specific to Alternative 2A

Stands dropped from Alternative 2 commercial thinning

Alternative 2A would drop stands totaling approximately 307 acres from proposed commercial thinning stands. Reasons that stands were dropped include: dropped areas would provide additional protection for resources such as wetlands or trails and/or the stand was greater than 80 years of age.

Table of commercial thinning stand changes in Alternative 2A

Stands to drop	Stand #	Acres	Reason for change
	g75	17.0	Stand is over 80 years old
	g77	9.7	Stand is over 80 years old
	m162	23.0	Field and map review - extensive wetland portions below road to river
	m165	78.6	Extensive wetland portion near river – adjacent to critical habitat for listed fish. Includes alder hardwood patches and beaver habitat
	m167	12.8	Extensive wetland portion near river – adjacent to critical habitat for listed fish. Includes alder hardwood patches and beaver habitat
	m4	27.9	Portion of stand west of Rd. 4020 is non-merchantable based on Lidar tree height
	p24	70.4	Heather Lake trail protection - Drop portion of stand above Trail, drop portion of stand midslope between Road 42 and trail to better buffer trail and meet visual management
	u188	24.3	Stand is over 80 years old
	u36	43.2	Portion of stand west of Road 4052 was previously thinned (circa 1996), stands exhibiting desired diversity and understory development
Total		306.9	There would be approximately 307 fewer acres of stands for commercial thinning with Alternative 2A

The commercial thinning treatment in Alternative 2A would have approximately 307 less acres of stands to be treated than Alternative 2. This is within the range of acres described in Alternative 2 for commercial thinning (2,160 to 3,600 acres).

Access and Travel Management

Alternative 2A would provide the same road management as in Alternative 2. System roads accessing stands classified as non-commercial at this time would be retained in storage (ML 1) for administrative use in future treatments. Non-specified roads would be candidates for decommissioning.

Actions Specific to Alternative 2B

Stands dropped from Alternative 2 commercial thinning and optional thinning stands added

Alternative 2B would drop stands totaling 330 acres from proposed commercial thinning stands and add the option of ground disturbing thinning of 241 acres currently rated as

non-commercial. Reasons that stands were dropped are similar to Alternative 2A: dropped areas would provide additional protection for resources such as wetlands or trails, field exams found stand ages over 80 years of age, and/or the stands were already exhibiting desirable diversity in stand structure and understory. Reasons for adding stands that were rated as non-commercial were to provide an array of options in meeting purpose and need, specifically enhancing desired wildlife habitat within forest stand types associated with spotted owl and marbled murrelet nesting habitat, and to better provide for habitat connectivity.

Stands that were added as an option for ground disturbing thinning treatments were based on LiDAR, field review of stands and priority of stand treatment from a wildlife perspective. Optional stands for thinning are in conjunction with adjacent commercial stands and would accomplish desired objectives for wildlife in support of the purpose and need of enhancing habitat conditions for old forest associated species. The optional stand treatment would also allow for additional roads to be considered for decommissioning.

Table of commercial thinning stand changes in Alternative 2B

Stands to drop	Stand #	Acres	Reason for change
	g59	23.1	Portions of stand have root-rot pockets providing snags with understory growth providing desired stand diversity
	g75	17.0	Stand classified as over 80 years old
	g77	9.7	Stand classified as over 80 years old
	m162	23.0	Field and map review - extensive wetland portions below road to river
	m165	78.6	Portion of stand with extensive wetland portion near river – adjacent to critical habitat for listed fish. Includes alder hardwood patches and beaver habitat
	m167	12.8	Portion of stand with extensive wetland portion near river – adjacent to critical habitat for listed fish. Includes alder hardwood patches and beaver habitat
	m4	27.9	Portion of stand west of Rd. 4020 is non-merchantable based on Lidar tree height
	p24	70.4	Heather Lake trail protection - Drop portion of stand above Trail, drop portion of stand midslope between Road 42 and trail to better buffer trail and meet visual management
	u188	24.3	Stand classified as over 80 years old
	u36	43.2	Portion of stand west of Road 4052 was previously thinned (circa 1996), stands exhibiting desired diversity and understory development
Total		330 ac.	
Optional Stands to add for potential thinning	m15	47.4	Thinning would provide wildlife connectivity and contribution to larger block of forest with old forest structure. Stand condition is based on field review and LiDAR review of tree height/density.
	m166	64.8	Treatment would contribute to large block of suitable old forest and potentially allow for road decommissioning following the treatments in stands M165 to M167. Stand condition is based on stand age and LiDAR review of tree height/density.
	m160	23.7	Treatment would contribute to large block of suitable old forest and potentially allow for road decommissioning following the treatments in stands M165 to M167. Stand condition is based on stand age and LiDAR review of tree height/density.
	m5	38.3	Treatment would provide for wildlife habitat connectivity in upper slope area. Road to adjacent trailhead provides access. Stand condition is based on field review and LiDAR review of tree height/density.

	u216	11.1	Treatment would be within a wildlife priority area for large blocks of suitable older forest characteristic. Stands are located in maturing stands of lower elevation western hemlock forest association in subdrainages with historic owl and murrelet detections. Stand condition is based on field review and LiDAR review of tree height/density.
	u217	24.8	Treatment would be within a wildlife priority area for large blocks of suitable older forest characteristic. Stands are located in maturing stands of lower elevation western hemlock forest association in subdrainages with historic owl and murrelet detections. Stand condition is based on field review and LiDAR review of tree height/density.
	u218	30.9	Treatment would be within a wildlife priority area for large blocks of suitable older forest characteristic. Stands are located in maturing stands of lower elevation western hemlock forest association in subdrainages with historic owl and murrelet detections. Stand condition is based on field review and LiDAR review of tree height/density.
	Total	241 ac.	
Total changes		- 89 ac	There would be approximately 90 fewer acres of stands with ground disturbing treatment activities

Alternative 2B would have approximately 90 less acres of stands with ground disturbance treated than Alternative 2. The amount of commercial thinning treatment in Alternative 2B is the same acres described in Alternative 2A for commercial thinning (2,160 to 3,600 acres), with additional stands for optional treatment identified depending on stand conditions at the time of the thinning sale preparation. The additional optional acres are located along road systems that are identified for use in the commercial thinning operations proposed in Alternative 2 and 2A.

Access and Travel Management

Alternative 2B would provide the same road management as in Alternative 2. System roads accessing stands classified as non-commercial at this time would be retained in storage (ML 1) for administrative use in future treatments. Non-specified roads would be candidates for decommissioning.

Alternative 2B would have the potential for additional road decommissioning on some road systems. For example, the treatment of optional acres could complete stand treatment or thinning in the Blackjack Creek to Bender Creek area on Road 4031 (beyond the junction with 4031-015). This would result in the accomplishment of desired thinning at this time and provide for the opportunity to decommission approximately 2. 5 miles of road that is currently in storage (ML1) in the No Action Alternative, Alternative 2 and Alternative 2A. Alternative 2B could provide final stand treatments for stands located at the end of roads, such as Road 4031 which would preclude need for future administrative access for that road segment of Road 4031.

2. Applicable Laws, Regulations, and Policies

Clean Water Act (CWA) of 1977 and subsequent amendments, makes it unlawful for any person to discharge any pollutant into waters of the United States, unless a permit was obtained under its provisions. Section 303 of the Clean Water Act requires the States to prepare a list of water bodies not meeting water quality standards and to conduct an analysis of the extent of the problem and develop a water cleanup plan (TMDL). The State of Washington has accepted management designation from EPA for implementation of the CWA. The State Department of Ecology maintains a list of impaired waterbodies and promulgates water quality standards that apply to all waters.

The National Forest Management Act of 1976 mandates…"the environmental protection to ensure timber harvesting will occur only where water quality and fish habitat are adequately protected from serious detriment; ensure clearcutting and other harvesting will occur only where it may be done in a manner consistent with the protection of soil, watersheds, fish, wildlife, recreation, aesthetic resources and regeneration of the timber resource."

3. Relevant Standards and Guidelines

1990 Mt.Baker-Stillaguamish Forest Plan, Forest-wide Standards and Guidelines, Water and Riparian Forest-wide Standards and Guidelines (pp. 4-117, 4-118, 4-119, 4-120):

Water Resources and Riparian Areas

- Limit acres of final harvest to meet the water quality and riparian management requirement. The management requirement, expressed as the maximum number of final harvest acres per watershed per decade (USDA Forest Service, 1990) (pp. 4-118 and 4-121).

- 2- Meet or exceed Water Quality Regulations for waters of the State (Washington administrative Code, chapter 173-201) through application of Best Management Practices. The key beneficial uses which BMP's are designed to protect are fish and water for domestic use (USDA Forest Service, 1990) (p. 4-118).

- Geographical boundaries of riparian areas will be determined by on-site characteristics. They are lands adjacent to perennial and intermittent streams, lakes, wetlands, ponds, springs (seeps), floodplains, or other wet areas (USDA Forest Service, 1990) (p. 4-119).
- 5 - Maintain the bank, flood plain, and shore stability of all wetlands, streams, lakes, and other bodies of water. Implicit in this standard are actions to prevent all forms of accelerated soil erosion and soil compaction, and the retention of the live root mat to the maximum practicable extent (USDA Forest Service, 1990) (p. 4-119).
- 6 - Riparian areas should be maintained in accordance with FSH 2526 MBS Supp. 01/81 or as revised (USDA Forest Service, 1990) (p. 4-119).

- 7 - Large woody material (plus trees) needed to meet the desired future condition shall be maintained and managed to: (1) maintain water quality in streamside management units of all streams at existing levels, and (2) maintain fish habitat at existing levels (USDA Forest Service, 1990) (p. 4-119).
- 8 - Maintain in-channel and streambank stability maintained for upper and lower channels in the Forest watersheds in order to provide stable, high quality habitat for salmon and trout, and provide high quality water for other in-stream beneficial uses (USDA Forest Service, 1990) (p. 4-119).
- 10 - Along perennial streams and fish bearing intermittent streams, vegetation should be maintained to provide cover and/or root strength so as to maintain streambank stability and fish habitat capability at existing levels (USDA Forest Service, 1990) (p. 4-119).
- Highly incised Class III streams shall be evaluated during the project planning process to determine if special measures may be required to protect significant riparian and/or associated riparian values. The evaluation should include an analysis of such factors as: soil stability, stream size and gradient, steepness and height of the inner gorge, and vegetative types. Depending upon these factors, special measures may be required (USDA Forest Service, 1990) (p. 4-119).
- For class I, II, and fish bearing class III streams, the maximum daily temperature shall not exceed 65 degrees F, and the average 7 day maximum temperature shall not exceed 60 degrees F. Exceptions must be based on scientific rationale, and must maintain the existing level of beneficial uses of the water, and be approved through NEPA analysis and documentation (USDA Forest Service, 1990) (p. 4-120).
- Consult with hydrologist if the activity being planned involves riparian areas, wet lands, flood plains, or probable cumulative impacts on water resources (USDA Forest Service, 1990) (p. 4-120).

<u>1994 Record of Decision for the Northwest Forest Plan,</u> Aquatic Conservation Strategy Objectives (ASCO) (USDA Forest Service and USDI Bureau of Land Management, 1994) (p. B-11):

ACSO #1 – Maintain and restore the distribution, diversity, and complexity of watershed and landscape-scale features to ensure protection of the aquatic systems to which species populations and communities are uniquely adapted.

ACSO #2 – Maintain and restore spatial and temporal connectivity within and between watersheds. Lateral, longitudinal, and drainage network connections include floodplains, wetlands, upslope areas, headwater tributaries, and intact refugia. These network connections must provide chemically and physically unobstructed routes to areas critical for fulfilling life history requirements of aquatic and riparian-dependent species.

ACSO #3 – Maintain and restore the physical integrity of the aquatic system, including shorelines, banks, and bottom configurations.

ACSO #4 – Maintain and Restore water quality necessary to support healthy riparian, aquatic, and wetland ecosystems. Water Quality must remain within the range that maintains the biological, physical, and chemical integrity of the system and benefits survival, growth, reproduction, and migration of individuals composing aquatic and riparian communities.

ACSO #5 – Maintain and restore the sediment regime under which aquatic ecosystems evolved. Elements of the sediment regime include the timing, volume, rate, and character of sediment input, storage, and transport.

ACSO #6 – Maintain and restore in-stream flows sufficient to create and sustain riparian, aquatic, and wetland habitats and to retain patterns of sediment, nutrient, and wood routing. The timing, magnitude, duration, and spatial distribution of peak, high, and low flows must be protected.

ACSO #7 – Maintain and restore the timing, variability, and duration of floodplain inundation and water table elevation in meadows and wetlands.

ACSO #8 – Maintain and restore the species composition and structural diversity of plant communities in riparian areas and wetlands to provide adequate summer and winter thermal regulation, nutrient filtering, appropriate rates of surface erosion, bank erosion, and channel migration and to supply amounts and distributions of coarse woody debris sufficient to sustain physical complexity and stability.

ACSO #9 – Maintain and restore habitat to support well-distributed populations of native plant, invertebrate and vertebrate riparian-dependent species.

1994 Record of Decision for the Northwest Forest Plan, Standards and Guidelines for Key Watersheds, (USDA Forest Service and USDI Bureau of Land Management, 1994) (p. C-7):

Key watersheds are highest priority for watershed restoration.

Outside Roadless inventoried (RARE II) areas (thereby including this project area) – reduce existing system and non-system road mileage. If funding in insufficient to implement reductions, there will be no net increase in the amount of roads in the Key watersheds.

Late-Successional Reserves

Relevant Standards and Guidelines:

- Projects designed to improve conditions for fish, wildlife, or watersheds should be considered if they provide late-successional habitat benefits or if their effect on late-successional associated species is negligible. Projects required for recovery of threatened or endangered species should be considered even if they result in some reduction of habitat quality for other late-successional species. Design and implement watershed restoration projects in a manner that is consistent with Late-

successional reserves objectives (USDA Forest Service and USDI Bureau of Land Management, 1994) (p. C-17).

Riparian Reserves

Relevant Standards and Guidelines:

TM-1. prohibit timber harvest, including fuel wood cutting in Riparian Reserves (RR), except when silvicultural practices would be applied for Riparian reserves to control stocking, reestablish and manage stands, and acquire desired vegetation characteristics needed to attain Aquatic Conservation Strategy objectives (ACOS) (USDA Forest Service and USDI Bureau of Land Management, 1994) (p. C-31).

1994 Record of Decision for the Northwest Forest Plan , Riparian Reserve Standards and Guidelines for Roads, Recreation, Lands, Riparian, and Watershed Restoration Management, (USDA Forest Service and USDI Bureau of Land Management, 1994) (pp. C-32, 33, 34, 36, 37):

Roads Management

RF-1. Federal, state, and county agencies should cooperate to achieve consistency in road design, operation, and maintenance necessary to attain Aquatic Conservation Strategy objectives.

RF-2. For each existing or planned road, meet Aquatic Conservation Strategy objectives by (USDA Forest Service and USDI Bureau of Land Management, 1994) (p. C-32):

a) minimizing road and landing locations in Riparian Reserves.
b) completing watershed analyses prior to construction of new roads or landings in Riparian Reserves.
c) preparing road design criteria, elements, and standards that govern construction and reconstruction.
d) preparing operation and maintenance criteria that govern road operation, maintenance, and management.
e) minimizing disruption of natural hydrologic flow paths, including diversion of streamflow and interception of surface and subsurface flow.
f) restricting sidecasting as necessary to prevent the introduction of sediment to streams.
g) avoiding wetlands entirely when constructing new roads.

RF-3. Determine the influence of each road on the Aquatic Conservation Strategy objectives through watershed analysis. Meet Aquatic Conservation Strategy objectives by (USDA Forest Service and USDI Bureau of Land Management, 1994) (p. C-32 and C-33):

a) reconstructing roads and associated drainage features that pose a substantial risk.
b) prioritizing reconstruction based on current and potential impact to riparian resources and the ecological value of the riparian resources affected.

c) closing and stabilizing, or obliterating and stabilizing roads based on the ongoing and potential effects to Aquatic Conservation Strategy objectives and considering short-term and long-term transportation needs.

RF-4. New culverts, bridges and other stream crossings shall be constructed, and existing culverts, bridges and other stream crossings determined to pose a substantial risk to riparian conditions will be improved, to accommodate at least the 100-year flood, including associated bedload and debris. Priority for upgrading will be based on the potential impact and the ecological value of the riparian resources affected. Crossings will be constructed and maintained to prevent diversion of streamflow out of the channel and down the road in the event of crossing failure (USDA Forest Service and USDI Bureau of Land Management, 1994) (p. C-33).

RF-5. Minimize sediment delivery to streams from roads. Outsloping of the roadway surface is preferred, except in cases where outsloping would increase sediment delivery to streams or where outsloping is unfeasible or unsafe. Route road drainage away from potentially unstable channels, fills, and hillslopes (USDA Forest Service and USDI Bureau of Land Management, 1994) (p. C-33).

RF-6. Provide and maintain fish passage at all road crossings of existing and potential fish-bearing streams (USDA Forest Service and USDI Bureau of Land Management, 1994) (p. C-33).

General Riparian Area Management

RA-2 Fell trees in Riparian Reserves when they pose a safety risk. Keep felled trees on-site when needed to meet coarse woody debris objectives (USDA Forest Service and USDI Bureau of Land Management, 1994) (p. C-37).

RA-4. Locate water drafting sites to minimize adverse effects on stream channel stability, sedimentation, and in-stream flows needed to maintain riparian resources, channel conditions, and fish habitat.

WR-1: Design and implement watershed restoration projects in a manner that promotes long-term ecological integrity of ecosystems, conserves the genetic integrity of native species, and attains ACS objectives (USDA Forest Service and USDI Bureau of Land Management, 1994) (p. C-37).

WR-3: Do not use mitigation or planned restoration as a substitute for preventing habitat degradation.

<u>Forest Service Manual Direction</u>

2522.11 - Watershed Condition Improvement
Install land treatment and structural measures to reduce erosion, stabilize land mass movement, mitigate adverse soil chemistry, and provide for favorable conditions of water flow. Measures include: vegetative and mechanical sheet erosion control; rehabilitation of abandoned roads and trails; stream bank, gully, and lakeshore stabilization; stream channel clearing; sediment basin construction; prescribed fire; insect and disease control; invasive plant control; and other activities designed to stabilize watersheds.

2526.03 – Riparian Area Management Policy

1. Manage riparian areas in relation to various legal mandates, including, but not limited to, those associated with floodplains, wetlands, water quality, dredged and fill material, endangered species, wild and scenic rivers, and cultural resources.
2. Manage riparian areas under the principles of multiple-use and sustained-yield, while emphasizing protection and improvement of soil, water, and vegetation, particularly because of their effects upon aquatic and wildlife resources. Give preferential consideration to riparian-dependent resources when conflicts among land use activities occur.
3. Delineate and evaluate riparian areas prior to implementing any project activity. Determine geographic boundaries of riparian areas by onsite characteristics of water, soil, and vegetation.
4. Give attention to land along all stream channels capable of supporting riparian vegetation (36 CFR 219.27e).
5. Give special attention to land and vegetation for approximately 100 feet from the edges of all perennial streams, lakes, and other bodies of water. This distance shall correspond to at least the recognizable area dominated by the riparian vegetation (36 CFR 219.27e). Give special attention to adjacent terrestrial areas to ensure adequate protection for the riparian-dependent resources.

2527.03 - Floodplain Management and Wetland Protection Policy

1. Recognize floodplains and wetlands as specific areas.
2. Provide opportunity for early public review of plans or proposals for actions in floodplains.
3. Avoid adverse impacts that may be associated with the occupancy and modification of floodplains and with the destruction, loss, or degradation of wetlands. Avoid filling of land within floodplains and wetlands wherever practicable.
4. Do not permit floodplain development and new construction in wetlands wherever there is a practicable alternative.
5. Promote nonstructural flood protection methods to reduce flood hazard and flood loss.
6. Preserve and, where needed and feasible both economically and technically, enhance the natural and beneficial function and values of wetlands.

2532.03 – Water Quality Management Policy

1. Promote and apply approved best management practices to all management activities as the method for control of non-point sources of water pollution, and for compliance with established state or national water quality goals.
4. Include a water quality evaluation for all environmental analyses (FSM 1950). Identify the water quality implications of proposed and alternative land management practices.

Watershed Analysis

The South Fork Stillaguamish Watershed Analysis (Upper South Fork and the Lower South Fork and Canyon Creek) (USDA Forest Service, 1995) (USDA Forest Service, 1996) was conducted to fulfill requirements of the NWFP 1994 where a watershed analysis must be completed before certain projects may proceed. The watershed analysis

recommends improvements of riparian structure, function, and diversity through silvicultural prescriptions. The Stillaguamish River Basin TMDL (DOE, 2007) calls for similar actions to meet State Water Quality Standards. Primary concerns from the TMDL study are maintaining shade over streams and reduction of the sediment loads in streams would create deeper, cooler streams that provide quality aquatic habitat.

4. Other Programmatic Direction

Memorandum of Agreement for Meeting Responsibilities under Federal and State Water Quality Laws (USDA Forest Service Region 6 and Washington Department of Ecology. 2000). This MOA outlines cooperative activities under the Clean Water Act for protection of water quality, with an emphasis on road management. Management and maintenance of Road 6420 must meet road stabilization requirements under WAC 222. The Forest Service agrees to provide the Department of Ecology information regarding water quality conditions for State waters on National Forest System lands. This agreement contains commitments for stabilizing the Forest road system.

Memorandum of Understanding between USDA Forest Service and Washington Department of Fish and Wildlife for Hydraulic Permits (Washington Department of Fish and Wildlife, 2012). This MOU lists conditions under which the Forest Service may complete projects affecting waters of the State without completing a Hydraulic Permit Application (HPA).

5. Definitions of Technical Terms (if needed)

Aquatic Ecosystems: The stream channel, lake or estuary bed, water, and biotic communities and the habitat features that occur therein.
Flood or Flooding: A general or temporary condition of partial or complete inundation of normally dry land areas from the overflow of inland and/or tidal waters, and/or the unusual and rapid accumulation or runoff of surface waters from any source.
Flood Risk: The probability that one or more events will exceed a given flood frequency within a specified period of years.
Floodplain: The lowland and relatively flat areas joining inland and coastal water including the debris cones and flood-prone areas of offshore islands and, at a minimum, that area subject to a 1 percent (100-year recurrence) or greater chance of flooding in any given year.
Hydrologic Condition: The current state of the processes controlling the yield, timing and quality of water in a watershed.
Hydrologic Function: The behavioral characteristics of a watershed described in terms of ability to sustain favorable conditions of water flow. Favorable conditions of water flow are defined in terms of water quality, quantity, and timing.
Perennial Streams: Permanently present surface water. Flows occur throughout the year except possibly during extreme drought or during extreme cold when ice forms.
Potential: The difference between current factor values and the capability to adjust toward reference condition values.

Reference: The range of a factor that is representative of its recent historical values prior to alteration of its environment.
Riparian Areas: Geographically delineable areas with distinctive resource values and characteristics that are comprised of the aquatic and riparian ecosystems.
Riparian-Dependent Resources: Resources that owe their existence to the riparian area.
Riparian Ecosystems: A transition area between the aquatic ecosystem and the adjacent terrestrial ecosystem; identified by soil characteristics or distinctive vegetation communities that require free or unbound water
Surface Erosion: is the detachment and transport of individual soil particles by wind, water, or gravity.
Tolerance: The point beyond which there is high risk that potential may be permanently altered or impaired through changes in specified physical, chemical, and biological factors brought about by management activities or natural events.
Watershed Condition: The state of a watershed based upon physical and biological characteristics and processes affecting hydrologic and soil functions. Refer to Fisheries section for some terms relating to hydrologic resources and effects. Management Requirements and Mitigation Measures

6. Management Requirements and Mitigation Measures

Forest management and associated road building in the steep rugged terrain of forested mountains has long been recognized as sources of non-point water quality pollution. Non-point pollution is not, by definition, controllable through conventional treatment means. It is controlled by containing the pollutant at its source, thereby precluding delivery to surface water. Sections 208 and 319 of the Federal Clean Water Act, as amended, acknowledge land treatment measures as being an effective means of controlling non-point sources of water pollution and emphasize their development.

The Forest Service developed and documented non-point pollution control measures applicable to National Forest System lands. These measures were termed "Best Management Practices" (BMPs). BMP control measures are designed to accommodate site specific conditions. They are tailor-made to account for the complexity and physical and biological variability of the natural environment. The implementation of BMPs is the performance standard against which the success of the Forest Service's non-point pollution water quality management efforts is judged.

The Clean Water Act provided the initial test of effectiveness of the Forest Service non-point pollution control measures where it required the evaluation of the practices by the regulatory agencies (EPA) and the certification and approval of the practices as the "BEST" measures for control. Another test of BMP effectiveness is the capability to custom fit them to a site-specific condition where non-point pollution potential exists. The Forest Service BMPs are flexible in that they are tailor-made to account for diverse combinations of physical and biological environmental circumstances. A final test of the effectiveness of the Forest Service BMP is their demonstrated ability to protect the beneficial uses of the surface waters in the State.

Best Management Practices, as described in this document have been effective in protecting beneficial uses within the affected watersheds. These practices have been applied in other projects within the Mt. Baker-Stillaguamish National Forest. Where proper implementation has occurred there have not been any substantive adverse impacts to cold water fisheries habitat conditions or primary contact recreation (etc.) use of the surface waters. The practices specified herein are expected to be equally effective in maintaining the identified beneficial uses.

The following management requirements are designed to address the watershed management concerns. These BMPs are found within the Forest Service publication "National Best Management Practices for Water Quality Management on National Forest System Lands" (USDA Forest Service, 2012). All applicable water quality BMPs shall be implemented. A list of BMPs used within the South Fork Stillaguamish River Vegetation Management Project is as follows along with a brief summary of what each entails:

Best Management Practices (BMPs)

Mechanical Vegetation Management Activities

Veg-1 Vegetation Management Planning: The objective of this BMP is to use the applicable vegetation management processes to develop measures to avoid, minimize, or mitigate adverse effects to soil, water quality, and riparian resources during mechanical vegetation treatment activities.

This NEPA document and analysis through an interdisciplinary team (IDT) process constitutes the implementation of this BMP. This analysis included the development of the following BMPs to protect soil, water quality, riparian resources, and the designated beneficial uses of water.

Veg-2 Erosion Prevention and Control: The objective of this BMP is to avoid, minimize, or mitigate adverse effects to soil, water quality, and riparian resources by implementing measures to control surface erosion, gully formation, mass slope failure, and resulting sediment movement before, during, and after mechanical vegetation treatments.

Maintenance and erosion control on landings, disturbed cable corridors, skid roads, and temporary and permanent roads would be completed prior to the onset of expected seasonal periods of precipitation or runoff, and kept current during and outside of Normal Operating Season (NOS).

As conditions require, sediment filters (straw bales, slash filter windrow, and/or sediment fence) would be placed in ditchlines along the haul route or in areas where ground is disturbed and sediment has the potential for delivery to streams (i.e. stream crossing fills, adjacent to downhill skyline units). Sediment filters would be maintained and adjusted as needed. Removal of sediment filters would be done when site conditions are dry, and captured sediment would be relocated to stable locations away from stream courses.

Areas of gouging or soil displacement on steep slopes resulting from yarding systems would be treated to prevent rill and gully erosion and possible sediment delivery to stream courses. Erosion control treatments may include, but are not limited to: repositioning displaced soil to re-contour disturbed sites; creating small ditches or diversions to redirect surface water movement; installation of coir logs along slope contours; and scattering slash material to create flow disruption and surface soil stability. These measures would be in place prior to expected seasonal periods of precipitation or runoff, and kept current during and outside of NOS.

Veg-3 Aquatic Management Zones: The objective of this BMP is to avoid, minimize, or mitigate adverse effects to soil, water quality, and riparian resources when conducting mechanical vegetation treatment activities in the aquatic management zone. Aquatic management zones are referred to as Riparian Reserves (RRs) on the Mt. Baker-Stillaguamish National Forest.

Within Riparian Reserves a no cut buffer (table 2) would be implemented in treatment units to retain riparian vegetation to provide shade to maintain stream temperatures and slope stability, minimize soil erosion, and to provide protection of aquatic and riparian species.

Table 2. Not Cut Stream Buffer Distance prescribed for the South Fork Stillaguamish Vegetation Project.

Stream	**No Cut Buffer Distance** **(to be measured from the edge of streambank or the top of inner gorge, whichever is greater)**
All Fish Barring Streams	100 Feet
Perennial Streams (non-fish barring), Wetlands, Ponds, Seeps, Springs, and Unstable Slopes	30 Feet
Intermittent Streams (non-fish barring)	15 Feet*

*In addition to the no cut buffers, no ground based equipment would be allowed within 25 feet of any waterbody or top of inner gorge, whichever is greater. Trees cut within this boundary would be felled and dragged out of this 25 feet buffer before being loaded on ground based equipment.

Veg-4 Ground-Based Skidding and Yarding Operations: The objective of this BMP is to avoid, minimize, or mitigate adverse effects to soil, water quality, and riparian

resources during ground-based skidding and yarding operations by minimizing site disturbance and controlling the introduction of sediment, nutrients, and chemical pollutants to waterbodies.

All yarding and haul activities would be restricted to a Normal Operating Season (NOS), defined as June 1 to October 15.

During periods of dry weather outside the NOS, yarding and haul operations may proceed with both: (1) written approval of an Aquatic Specialist; and (2) monitoring weather and conditions to evaluate if wet weather logging operations meet project design elements and Management Requirements and Mitigation Measures.

Any pre-approved hauling activities occurring outside of the NOS defined as June 1 to October 15 would require monitoring of daily conditions as follows:

- Implementation and effectiveness monitoring of BMPs would be documented in daily diaries and made available to the Aquatic Specialist to assess conditions of haul routes, landings, and skid trails.

- Potentially damaging project activities would be curtailed and corrective action taken when ponding, rutting, rilling, and the occurrence of scour or sediment transport and deposition downstream of cross drains are encountered on adjacent system roads, temporary roads, skid trails, landings, haul routes, stream crossings, riparian reserves or within harvest units where ground disturbance has occurred.

If it is necessary for equipment to travel away from approved corridors or temporary roads, the machines would operate on a slash mat of limbs and tops that is deposited directly in front of the machine. This mat would be as thick and continuous as practicable. Activities would be planned to make as few trips as possible.

Ground-based log transport equipment is restricted to sustained slopes that are no greater than 35 percent. Non-yarding ground-based equipment is restricted to sustained slopes less than 50 percent.

For ground-based yarding:

- Skid trails must be approved by the Timber Sale Administrator prior to felling and construction operations.

- In preference to the construction of new skid trails, old skid trails would be used wherever possible, as long as they avoid wet areas and would prevent sediment delivery to streams.

- Skid trails would generally be no closer than 100 feet apart, center-to-center, and be only as wide as necessary for the equipment to travel (less than 15 feet wherever possible). Erosion control devices such as waterbars and/or slash would be used as necessary on sloped skid roads.

- Line-pulling (winching) would be accomplished by yarding logs to lead, or at a 30 to 45-degree angle, whenever possible. Full suspension of logs is not required during lining operations.

- Ground-based skidding and yarding operations shall be conducted in a workman-like manner, with one-end suspension to minimize soil erosion.

- Wherever possible, skid trails would be located a minimum of 25 feet away from riparian no-cut buffers.

- To travel off approved skid trails, equipment (i.e. harvester, feller/buncher, shovel) would operate on a slash mat whenever possible. The slash mat should consist of limbs and tops deposited directly in front of the machine. The mat would be thick and continuous as practicable. Activities would be planned to make as few trips as possible.

Veg-5 Cable Yarding Operations: The objective of this BMP is to avoid, minimize, or mitigate adverse effects to soil, water quality, and riparian resources during cable yarding operations by minimizing site disturbance and controlling the introduction of sediment, nutrients, and chemical pollutants to waterbodies.

Directionally fall trees away from no-cut riparian buffers where possible to protect riparian vegetation and soils from damage.

- Trees inadvertently felled into no-cut buffers may be removed with one-end suspension.

- Trees felled for temporary road construction within no-cut buffers shall be left on-site within the no-cut area on the downhill side of the road as to not plug any water control features.

Avoid harvest on areas that have average sideslopes greater than 80 percent, unless they have been approved by Aquatic Specialist. Some trees may be cut on slopes steeper than 80 percent for occasional cable corridors in order to access areas of a unit less than 80 percent.

If mobile or other anchors are needed outside of cutting units that may result in impacts to soils, use would require approval of Aquatics Specialist.

Yarding would only be allowed through, across or over potentially unstable slopes, streams, wetlands, wet areas, and other no-cut buffers is logs are fully suspended. Corridors would, whenever possible, be no more than 15 feet wide. All corridors would generally be at least 120 feet apart and would have at least one end suspension unless approved by an Aquatic Specialists.

Veg-6 Landings: The objective of this BMP is to avoid, minimize, or mitigate adverse effects to soil, water quality, and riparian resources from the construction and use of log landings.

Existing landings and turnarounds would be utilized where ever possible. When constructing landings or new turnarounds:

- No unanalyzed landings or turnarounds would be constructed outside of unit boundaries without consultation with the Project ID Team.

- Make all attempts to locate new landings or turnarounds a minimum 150-foot slope distance from rivers, streams, ponds, seeps, wetlands, and wet areas. If location outside of the 150-foot slope distance is not possible, then landings or turnarounds should be at least 50 feet slope distance away from no-cut stream and wet area buffers.

- If landings or turnarounds must be located within 150-foot slope distance, they would be placed on existing roadways or on existing landings that require only minimum reconstruction (e.g., clearing vegetation, sloping for drainage, or surfacing for erosion control purposes) to be made suitable for use.

- Any new landing or turnaround construction areas (or portions thereof), which are not located on existing roadways or cleared, compacted areas, would be decompacted, contoured, and mulched with certified weed-free straw, woodstraw, or slash after use, and/or seeded with erosion control seed mix or planted with native vegetation as prescribed by botany and silvicultural prescriptions

Road Management Activities

Road-1 Travel Management Planning and Analysis: The objective of this BMP is to use the travel management planning and analysis process to develop measures to avoid, minimize, or mitigate adverse effects to soil, water quality, and riparian resources during road management activities.

This NEPA document and analysis through an interdisciplinary team (IDT) process constitutes the implementation of this BMP. This analysis included the development of the following BMPs to protect soil, water quality, riparian resources, and the designated beneficial uses of water.

Road-2 Road Location and Design: The objective of this BMP is to locate and design roads, to minimize, or mitigate adverse effects to soil, water quality, and riparian resources.

If temporary roads, other than those identified and shown on EA alternative maps, are proposed for construction they must: be located within harvest unit boundaries; outside of sensitive and shallow soils; outside of unstable landforms; avoid wetlands entirely; and minimize disruption of natural hydrologic flow paths, including surface and subsurface flow. Upon additions or changes to the road system, consult Aquatics Specialist to ensure changes are within the effects analyzed.

Road-3 Road Construction and Reconstruction: The objective of this BMP is to avoid or minimize adverse effects to soil, water quality, and riparian resources from erosion, sediment, and other pollutant delivery during road construction or reconstruction.

Existing, unclassified, and previously decommissioned roads would be reconstructed in a way that adequately addresses road drainage, cutslope and fillslope instability, and potential water diversions. Sidecasting of loose material is prohibited within 150 feet of aquatic resources.

Road-4 Road Operations and Maintenance: The objective of this BMP is avoid , minimize, or mitigate adverse effects to soil, water quality, and riparian resources by controlling road use and operations and providing adequate and appropriate maintenance to minimize sediment production and other pollutants during the useful life of the road.

Schedule road reconstruction and maintenance activities during the NOS.

Spot rocking must be completed during the NOS to make roads acceptable for wet season haul.

Exceptions shall be approved by the Aquatics Specialist.

Road-5 Temporary Roads: The objective of this BMP is to avoid, minimize, or mitigate adverse effects to soil, water quality, and riparian resources from construction and use of temporary roads.

New temporary roads, including those identified and shown on EA alternative maps would be located and designed to minimize disruption to hydrologic flows by:

- Minimizing clearing limits (generally no more than 16 feet on level ground, 20 feet for curves, slightly more for steeper hillslopes);
- Minimizing excavation of cutslopes and fillslopes; and
- Routing drainage away from potentially unstable hillslopes, sidecast, and channels.

Road-6 Road Storage and Decommissioning: The objective of this BMP is to avoid, minimize, or mitigate adverse effects to soil, water quality, and riparian resources by storing closed roads not needed for at least 1 year (intermittent stored service) and decommissioning unneeded roads in a hydrologically stable manner to eliminate hydrologic connectivity, restore natural flow patterns, and minimize soil erosion.

Roadbeds of decommissioned and obliterated roads would be reclaimed to resist erosion, improve subsurface hydrology, improve regrowth, and deter motorized traffic. Reclamation may include: (1) improving the infiltration by decompaction to a depth of 18 inches, and/or outsloping towards the natural contour; and (2) stabilizing the surface by either applying mulch or by distributing slash across 70 percent of the disturbed ground surface, whichever is appropriate, and seeded with appropriate mix as described in mitigation BOT11. Planting riparian vegetation would occur where road segments pass

through aquatic no-cut buffers. Whenever possible, planting may include the salvage of riparian vegetation clumps during road construction to be replaced during obliteration.

During road obliteration or decommission activities, remove all fill material and man-made structures from stream channels. After removal, stream channel shall match upstream and downstream channel dimensions, channel roughness, bank shape, natural floodplain contours, and natural adjacent hillslope.

Aquatic Specialist shall approve final specifications for stream crossing removal, outsloping and road-decommissioning designs.

Road-7 Stream Crossing: The objective of this BMP is to avoid, minimize, or mitigate adverse effects to soil, water quality, and riparian resources when constructing, or maintaining temporary and permanent waterbody crossings.

When reconstructing roads, install stream-crossing structures at the location where water flows into roadbed. All installed culverts or crossing features should maintain flow down primary, natural pathway of flow and not redirect flow into a ditch, pond, or another channel. Exceptions may be approved by the Aquatics Specialist.

Perennial stream crossings should be reconstructed and maintained to prevent diversion of streamflow out of the channel and down the road in the event of crossing failure. This may involve cleanout of plugged culvert inlets, lowering of road fill at the culvert crossing, and/or construction of a drivable dip downgrade of the crossing.

Any timber sale temporary access roads identified to remain in place over the winter (into a second year of operation) shall use drainage features (culverts and/or water bars) that would accommodate a 100-year flood and associated debris flow, including seeding and mulching of any exposed or disturbed soils.

Road-9 Parking and Staging Areas: The objective of this BMP is to avoid, minimize, or mitigate adverse effects to soil, water quality, and riparian resources when constructing and maintaining parking and staging areas.

All parking and staging areas would be treated the same as landings and turn arounds (BMP Veg-6).

Existing landings and turnarounds would be utilized where ever possible. When constructing landings or new turnarounds:

- No unanalyzed landings or turnarounds would be constructed outside of unit boundaries without consultation with the Project ID Team.

- Make all attempts to locate new landings or turnarounds a minimum 150-foot slope distance from rivers, streams, ponds, seeps, wetlands, and wet areas. If location outside of the 150-foot slope distance is not possible, then landings or turnarounds should be at least 50 feet slope distance away from no-cut stream and wet area buffers.

- If landings or turnarounds must be located within 150-foot slope distance, they would be placed on existing roadways or on existing landings that require only minimum reconstruction (e.g., clearing vegetation, sloping for drainage, or surfacing for erosion control purposes) to be made suitable for use.

- Any new landing or turnaround construction areas (or portions thereof), which are not located on existing roadways or cleared, compacted areas, would be decompacted, contoured, and mulched with certified weed-free straw, woodstraw, or slash after use, and/or seeded with erosion control seed mix or planted with native vegetation as prescribed by botany and silvicultural prescriptions

Road-10 Equipment Refueling and Servicing: The objective of this BMP is to avoid or minimize adverse effects to soil, water quality, and riparian resources from fuels, lubricants, cleaners, and other harmful materials discharging into nearby surface waters or infiltrating through soils to contaminate groundwater resources during equipment refueling and servicing activities.

Heavy machinery and project service vehicles shall be free of leaks. Operators shall check heavy machinery for leaks prior to commencement of daily work. Repairs would be conducted before commencement of or continuing work.

Establish a Spill Prevention Control and Containment Plan (SPCCP) and maintain a spill remediation kit onsite for any fuel stored on NFS lands in association with this project. Fuels stored on NFS lands shall be 100 feet from aquatic resources.

Pumps and generators shall be kept and operated on a sorbent pad or petroleum containment basin with 150% of the pumps' fuel capacity. All petroleum products will be secured in self-contained safety cans.

Water Uses Management Activities

WatUses-1 Water Uses Planning: The objective of this BMP is to use the administrative planning process to develop measures to avoid, minimize, or mitigate adverse effects to soil, water quality, and riparian resources during construction, operation, maintenance, and restoration of water use infrastructure.

This NEPA document and analysis through an interdisciplinary team (IDT) process constitutes the implementation of this BMP. This analysis included the development of the following BMPs to protect soil, water quality, riparian resources, and the designated beneficial uses of water.

WatUses-3 Administrative Water Developments: The objective of this BMP is to avoid, minimize, or mitigate adverse effects to soil, water quality, and riparian resources when developing and operating water sources for Forest Service administrative and resource management purposes.

Approved water sources would be shown on timber sale maps and/or listed in the sale contract. If additional water sources are needed, they would be reviewed and approved by an Aquatics Specialist before water withdrawal activities can occur.

- No more than 10% of the instantaneous stream flow may be removed at any time.

- An air gap or positive anti-siphon device shall be provided between the water source and the holding tank if the tank has been used for purposes other than water haul, if the source is a domestic water supply, or if the water is being mixed with any other materials.

- The withdrawal hose or pipe must be fitted with a screen with a minimum effective surface area of at least one square inch of functional screen area for every gallon per minute (gpm) of water drawn through it, a round or square screen mesh that is no larger than 2.38 mm in the narrow dimension, or any other shape that is no larger than 1.75 mm in the narrow dimension.

- Designated water sources may require work including cleaning ponded areas, pipe repair, and pump installation. Bags filled with pea gravel may be used, or a weir may be placed across the stream to pond water. No fill or woody material may be used to seal the water retention area within the bankfull channel. All bags or weirs shall be completely removed at the end of the NOS. Obtain approval from Timber Sale Administrator prior to working on water sources.

Recreation Management Activities

Rec-1 Recreation Planning: The objective of this BMP is to use the applicable recreation planning process to develop measures to avoid, minimize, or mitigate adverse effects to soil, water quality, and riparian resources during recreation activities.

This NEPA document and analysis through an interdisciplinary team (IDT) process constitutes the implementation of this BMP. This analysis included the development of the following BMPs to protect water quality, riparian resources, soil resources, and the designated beneficial uses of water.

Rec-2 Developed Recreation Sites: The objective of this BMP is to avoid, minimize, or mitigate adverse effects to soil, water quality, and riparian resources at developed recreation sites by maintaining desired levels of ground cover, limiting soil compaction, and minimizing pollutants entering water bodies.

This project would develop new developed trailheads for the Sunrise Mine Trailhead and Mallardy Trailhead. The Heather Lake Trailhead would be expanded. These new trailheads and expansions would follow the same mitigations as BMP Veg-6 Landings and Roads-9 Parking and Staging Areas. The only difference is these areas would be a permanent recreation facility. Implemented BMPs would be installed and maintained accordingly.

- No unanalyzed sites would be constructed outside of proposed boundaries without consultation with the Project ID Team.

- Make all attempts to locate new trailheads a minimum 150-foot slope distance from rivers, streams, ponds, seeps, wetlands, and wet areas. If location outside of the 150-

foot slope distance is not possible, then trailheads should be at least 50 feet slope distance away from no-cut stream and wet area buffers.

- If trailheads must be located within 150-foot slope distance, they would be placed on existing roadways or on existing trailheads that require only minimum reconstruction (e.g., clearing vegetation, sloping for drainage, or surfacing for erosion control purposes) to be made suitable for use.

Rec-4 Non-motorized Trails: The objective of this BMP is to avoid, minimize, or mitigate adverse effects to soil, water quality, and riparian resources by controlling soil erosion, erosion of trail surface materials, and water quality problems originating from construction, maintenance, and use of non-motorized trails.

All proposed new trail connectors in addition to routine maintenance of trails would be conducted to Forest Service standards to protect water quality and the designated beneficial uses of water. This work would occur by hand and when conditions are dry. Water Control structures could include; outsloping the trail, rolling dips/water bars, log or rock waterbars, turnpike with lead off ditches, and puncheon bridges.

Water control structures would be maintained by the standards located in table 3. When implementing new trail construction and trail maintenance, if there is a need to deviate from these standards on a site specific basis a hydrologist or fish biologist would be consulted prior to implementation.

Table 3: Water Control Structure Requirements

% Slope	Spacing
0-15	125 Feet
15-35	45 Feet

7. Analysis Methodology, Assumptions

The beneficial resources of concern relative to water resources that are pertinent to this project are: the protection from any degradation of habitats due to changes in peak or base flow hydrology; protection of riparian and instream habitats from degradation due to delivery of sediments due to logging, yarding, road construction, road closure and decommissioning; and protection of wetlands and waters of the United States.

The potential effects relative to water resources for this project are described below, along with the appropriate metric indicator for that issue to assess possible impact from

the various project actions. The appropriate spatial and temporal scales for each issue are also described.

Water Quantity Effects

Proposed timber harvest would reduce the number of trees per acre and reduce canopy closure in all units in the short term.

Background: Timber harvest would result in a reduction in canopy interception of rainfall and snowfall, with resultant decreases in evaporation and ablation. It would also result in decreased levels of evapotranspiration and root cohesion, and differences in accumulation and melting of snowpacks under timber stands. The consequence of these effects is that the timing and magnitude of snow melt, infiltration rates, and stream recharge rates may potentially be altered to a measurable degree.

The effects of forest harvest, primarily clearcut harvest, on storm runoff from rain-on-snow storms have been documented for some time (Harr R. D., 1981) (Harr R. , 1986) (Coffin, 1992). Efforts to estimate the effects of selective harvest are ongoing. It is not possible to accurately quantify the changes in stream flow regimes due to timber harvest. It is possible estimate relative changes in the timing and magnitude of peak flows. Roads and other disturbed soils also affect peak flows by creating additional flow paths for surface and ground water to more rapidly enter stream channels (Jones, 1996).

The analysis in this EA uses the vegetation disturbance concept as developed for the Forest Plan watershed cumulative effects analysis (USDA Forest Service, 1991) as a surrogate measure for the risk of peak flow increases. The concept is that acres of harvest and fire, and miles of road are an indicator of overall watershed disturbance. Percent disturbance is used to account for the effects of forest cover, soil compaction, and roads on runoff rates. For a full discussion of the scientific basis for the approach, see USDA Forest Service (USDA Forest Service, 1991).

Measurement Indicators: Percent of watershed considered to be hydrologically immature state.

Analysis Area and Temporal scale: Analysis of direct, indirect, and cumulative impacts focuses on the areas where the impact of decreased canopy cover may have the potential to measurably affect the timing and magnitude of precipitation inputs into the soil and groundwater, or directly into surface waters. The area selected for this analysis is the entire subwatershed area where harvest units, or constructed or re-constructed roads are located. This area includes 32 subwatersheds located within the South Fork Stillaguamish River watershed. Cumulative effects will be assessed for the entire affected watershed and is not limited to the project area.

The appropriate temporal scale for assessing effects is the time when harvest prescriptions would result in post-harvest vegetation disturbance levels of more than 12% of any subwatershed having less than 70% crown closure. When areas are found to exceed this threshold, further detailed analysis based on site-scale information is needed

to determine if the effects of vegetation disturbances would have a measurable impact on peak or base flows.

Water Quality Effects

Selective timber harvest, yarding activities, and/or temporary road construction in Riparian Reserves may result in increased water temperatures or changes in nutrient or sediment inputs in some stream reaches.

Suspended Sediment

Background: Road networks are the most important source of accelerated delivery of sediment to anadromous fish habitats in forested watersheds of the Pacific Northwest (Ice, 1985) (Swanson, Benda, & Duncan, 1987). Sediment from the road system can be delivered to streams by direct erosion of cut and fillslopes associated with stream crossings, or by surface runoff from roads and ditches that carries sediment-laden water directly or indirectly to streams. Not all sediment production from roadways reaches the aquatic system, because surface runoff from road surfaces and ditches is often directed to unchanneled slopes below the road where runoff has the potential to infiltrate the ground surface or the sediment settles out onto the forest floor before entering the stream network.

Measurement Indicators: The amount of sediment to be generated by project related activities and in relation to natural suspended sediment loads.

Analysis Area and Temporal scale: Analysis of direct, indirect, and cumulative impacts focuses on the areas where road-related activities have the potential to produce sediment in this project, which will be at both the site and subwatershed-scale. These actions include log haul and the associated road work, specifically:

- Road maintenance and improvements
- Temporary road construction
- Post-harvest Road Closure and Decommissioning

Stream Temperature

Background: Washington State administrative Code (WAC) standards for water quality of surface waters in the State include quantitative or qualitative thresholds for many variables, including maximum thresholds for water temperature and sediment. Along with sediment inputs (discussed above), water temperature concentrations represent the water quality variable that could most likely potentially be affected by project actions though thinning prescriptions in riparian reserves.

Measurement Indicators: Estimated lineal feet of stream(s) where shade-producing vegetation over stream(s) would be reduced to less than 70% canopy cover over the short-term; number of road-stream intersections.

Analysis Area and Temporal scale: Analysis of direct, indirect, and cumulative impacts focuses on the areas where the impact of decreased canopy cover may have the potential

to measurably affect shading of surface waters, and hence water temperature and dissolved oxygen concentrations (latter is inversely correlated with increasing water temperature). The area selected for this analysis is the prescribed thins within riparian reserves.

Riparian Reserves

The proposed ground disturbing work may impact the Riparian Reserves through clearing, grading, road construction, and all other timber harvesting activities resulting in alteration of surface and subsurface hydrology.

Background: National Wetland Inventories and National Hydrography Dataset stream inventories, Washington State Department of Fish and Game stream layer and the USDA Forest Service stream layer were reviewed for initial distribution of aquatic resources in the initially proposed timber harvest units. These GIS layers from different sources all have been proven to underrepresent the number and position of streams and other aquatic resources across particular forest landscapes. To ensure aquatic resources are identified, and protected, field surveys were then performed during 2015 and 2016. Surveys included all proposed vegetation management units and all roads where work would be performed under this project, as well as the areas within 100 feet of these locations. These areas were visited by hydrologists, botanists, and soil scientists for the proper identification of seeps, springs, wet areas, hydrophilic vegetation, hydric soils, and wetlands. All identified features were mapped using field GPS techniques and subsequently digitized into GIS to ensure they were tracked and integrated into the proposal for vegetation management activities. The proposed ground disturbing work could result in the loss of riparian and hydraulic functions to support Riparian Dependent Resources.

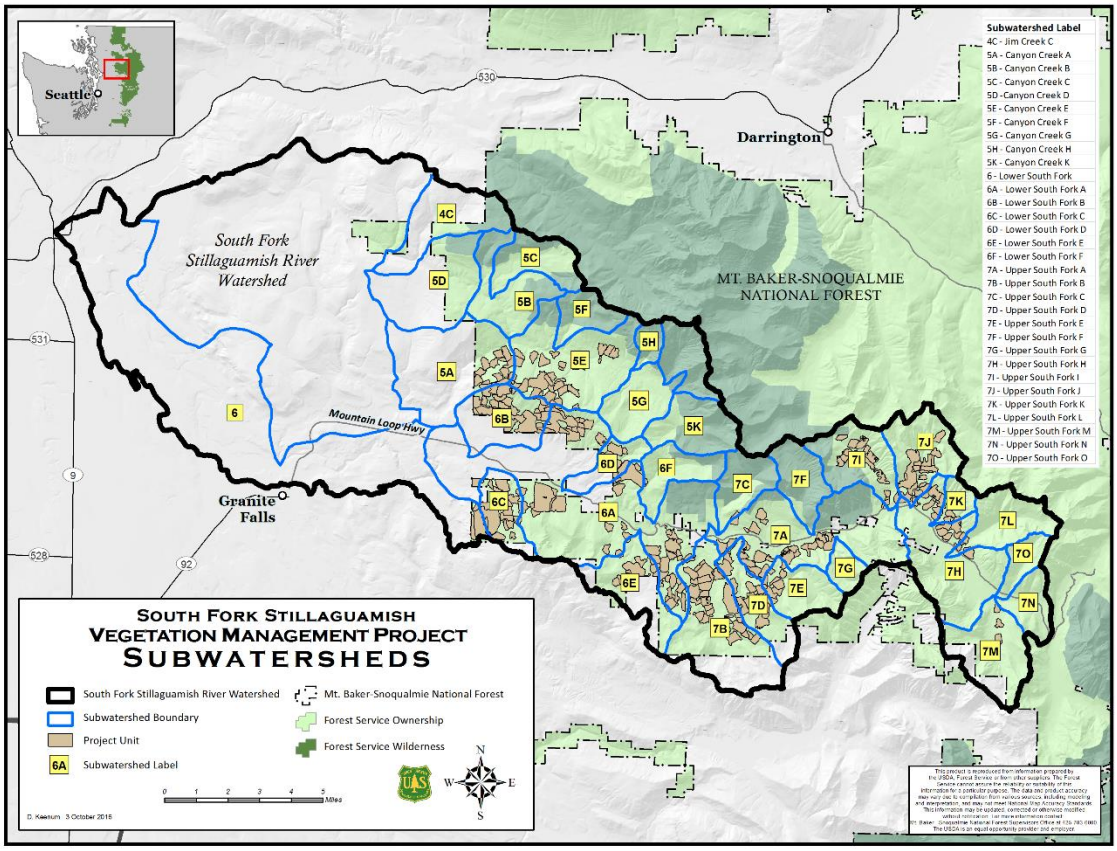
Indicators: Acreage of Riparian Reserves resources altered through project activities and narrative discussion of implications.

Analysis area: Analysis of direct and indirect impacts focuses on the areas of physical disturbance within the Riparian Reserves due to the project. This analysis area was specifically focused on identifying impacts to the function of riparian areas and riparian dependent resources.

8. Affected Environment

The proposed project is located in the South Fork Stillaguamish River Watershed (HUC 5 watershed number 1711000802) (Figure 2). The South Fork Stillaguamish is a primary tributary to the Stillaguamish River draining the western flanks of the Cascade Range in the Puget Sound Basin above the city of Arlington, WA.

Figure 2. The project area watershed is composed of the subwatersheds shown located in the South Fork Stillaguamish River Watershed HU-1711000802.



The project area watershed for hydrology analysis includes 7 HUC 6 watersheds. HUC 6 watersheds are nested within HUC 5 watersheds. Table 4 includes a list of all affected HUC 5 and HUC 6 watersheds within the project area and the area in square miles located within the project area. Of the approximately 194 square mile project area watershed (this includes all historic subwatersheds), 51percent is National Forest System Lands (NFS), 49 percent is State and private, and 11percent of the area within NFS is located within the Boulder River Wilderness.

Table 4. HUC 5 and HUC 6 watersheds within the South Fork Stillaguamish River Vegetation Management Project Area

HUC 5 Watersheds	HUC 6 Watersheds	Area Within Project Area (Square Miles)
South Fork Stillaguamish River	Headwaters South Fork Stillaguamish River	29.9

1711000802	171100080201	
	Upper South Fork South Fork Stillaguamish River 171100080202	26.2
	Middle South Fork Stillaguamish River 171100080203	23.2
	North and South Fork of Canyon Creek 171100080204	19.7
	Canyon Creek 171100080205	2.4
	Jim Creek 171100080206	0.4

Thirty two historic subwatersheds were used for analysis and were identified in the 1995 South Fork Upper Stillaguamish River Watershed Analysis and the 1996 South Fork Lower Stillaguamish-Canyon Creek within the project area. These subwatersheds were utilized for comparison purposes (Figure 2), subwatersheds are nested within HUC 6 watersheds. The watershed analyses characterized the watershed processes and aquatic conditions for the entire watershed area and subwatersheds surrounding the project. All of these subwatersheds follow the historic USGS subwatershed delineations.

Water Quantity

Vegetation Disturbance

The timber units of the proposed South Fork Stillaguamish River Vegetation Project is located within lands of historic road building and timber harvesting. The Upper South Fork Stillaguamish River Watershed Analysis (USDA Forest Service, 1995) and the

Lower South Fork Stillaguamish River and Canyon Creek Watershed Analysis (USDA Forest Service, 1996) identified the vegetation disturbance levels at the watershed scale peaking in the 1970s near 11% and again in the early 1990s near 10.5% (Table 5).

Observing that past disturbances are not evenly distributed throughout the watershed, disturbances were calculated for the subwatershed areas with values ranging from 0% in subwatershed Upper South Fork G and up to 13.2% in Lower South Fork during modeling year 2017 (calculated using the Forest Rain on Snow Model). Subwatersheds Canyon Creek G and Lower South Fork both show there to be residual vegetation disturbances in exceedance of 12%. These subwatersheds are still disturbed by past management efforts, including significant timber harvesting in the headwater areas and persisting disturbances from roads. The elevated effects of these past disturbances can be observed in disturbed geomorphology of the primary tributary channels for each of these subwatersheds in exceedance.

Table 5. Vegetation disturbance in the project area watershed and subwatersheds.

Watershed Name and project Area Subwatersheds	% Vegetation Disturbance in 2017
All Project area watersheds	4.7
Jim Creek C	3.8
Canyon Creek A	9.1
Canyon Creek B	4.9
Canyon Creek C	4.8
Canyon Creek D	10.5
Canyon Creek E	7.2
Canyon Creek F	0.7
Canyon Creek G	12.2
Canyon Creek H	0.3
Canyon Creek K	2.7
Lower South Fork	13.2
Lower South Fork A	4.7
Lower South Fork B	6.2
Lower South Fork C	11.2
Lower South Fork D	8.5
Lower South Fork E	5.2
Lower South Fork F	6.7
Upper South Fork A	2.6
Upper South Fork B	6.5
Upper South Fork C	1.2
Upper South Fork D	9.4

Upper South Fork E	3.5
Upper South Fork F	0.2
Upper South Fork G	0
Upper South Fork H	2
Upper South Fork I	3
Upper South Fork J	2.7
Upper South Fork K	2.6
Upper South Fork L	0.7
Upper South Fork M	0.7
Upper South Fork N	0.3
Upper South Fork O	0.04

River flow and floods

The stream gage record for the South Fork Stillaguamish River near Granite Falls is located downstream of the project area (USGS Gaging Station #12161000—beginning in 1928 with 52 years of record) indicates that the annual flow peak usually results from rain-on-snow (ROS) events in October through February (USGS, 2016). Approximately 40 percent of the project area watershed is located in the dominant ROS zone between 1500 feet and 3000 feet (USDA Forest Service, 1995) (USDA Forest Service, 1996). Recent large floods caused by rain-on-snow events within the 254 mi^2 drainage above the gage include:

February 1932 (225 cfs/mi^2)
February 1951 (213 cfs/mi^2)
January 1935 (198 cfs/mi^2)
December 1975 (150 cfs/mi^2)

Water Quality

Beneficial uses of water for the South Fork Stillaguamish River Watershed are designated by Washington State Department of Ecology (DOE) within the publication "Water Quality Standards for Surface Waters of the State of Washington." (DOE, 2011) The designated beneficial uses of water for all waterbodies within and downstream of the project area include: Char Spawning/Rearing, Core Summer Habitat (downstream of project area), Spawning/Rearing (downstream of project area), Extraordinary Primary Contact and Primary Contact (Recreation Uses), Domestic Water Supply, Industrial Water Supply, Agricultural Water Supply, Stock Watering, Wildlife Habitat, Fish Harvesting, Commerce/Navigation, Boating, and Aesthetics. Within the same publication DOE published water quality standards for the previously mentioned beneficial uses. Where water quality parameters have not been met, waterbodies are listed as 303d water quality impaired. There are two 303d listed waterbodies downstream of the project area. The South Fork Stillaguamish River has been listed as a 303d waterbody for Temperature and Dissolved Oxygen (immediately downstream of project

area) and Turlo Creek has been listed as a 303d waterbody for pH (downstream of the project area).

The Stillaguamish River Fecal Coliform, Dissolved Oxygen, pH, Mercury, and Temperature TMDL (DOE, 2007) was developed in response to the 303d water quality issues within the watershed. The TMDL calls for improvements to Riparian areas, stabilizing and decommissioning roads to reduce sediment, reduction of peak flow and stream temperature altering timber harvesting activities. Past effort projects have reduced road densities by approximately 49% through decommissioning and proper storage, most of this past work has been within the Canyon Creek area (Table 6). Reduction of road miles and stabilization of the remaining miles is ongoing and important for reducing sediment and streamflow conditions to the watersheds.

Directly tied to temperature issues and water quality is sedimentation in the South Fork Stillaguamish River. Past timber harvesting and road building activities detrimentally altered the sediment regimes in many of the subwatersheds. Subwatersheds with the greatest impacts are those with the highest density of roads as identified in the Upper South Fork Stillaguamish River Watershed Analysis (USDA Forest Service, 1995) and the Lower South Fork Stillaguamish River and Canyon Creek Watershed Analysis (USDA Forest Service, 1996) (Figure 1). Since 1995, road reduction activities have reduced aquatic risk by stabilizing many miles of road as well as decommissioning roads no longer needed for land management. A 49% overall reduction in the road system throughout the project area watershed has been achieved with 35-90% reductions in those subwatersheds functioning at risk above 2mi/mi^2.

Table 6. Road densities within project area subwatersheds.

Subwatershed	Subwatershed Area (mi^2)	Existing Road Length (mi)	Existing Road density (mi/mi^2)	S. Fk. Stillaguamish Road density (1995) (mi/mi^2)	% Reduction in Density since 1995
All Project area watersheds	194.15	101.38	0.52	1.02	49
Jim Creek C	5.68	0.41	0.07	0.20	64
Canyon Creek A	9.42	4.74	0.50	0.69	27
Canyon Creek B	4.57	4.62	1.01	1.45	30
Canyon Creek C	3.56	5.02	1.41	2.23	37
Canyon Creek D	7.17	5.06	0.71	0.86	18
Canyon Creek E	9.16	12.52	1.37	2.87	52
Canyon Creek F	2.29	1.04	0.46	0.61	25
Canyon Creek G	3.76	0.94	0.25	2.58	90
Canyon Creek H	1.02	0.00	0.00	0.22	100
Canyon Creek K	4.13	0.00	0.00	0.15	100
Lower SF	34.44	1.75	0.05	0.06	11
Lower SF A	23.47	19.53	0.83	1.58	47
Lower SF B	4.77	6.06	1.27	2.46	48

Lower SF C	2.95	4.97	1.68	2.79	40
Lower SF D	2.13	0.32	0.15	1.97	92
Lower SF E	4.77	2.06	0.43	0.86	50
Lower SF F	3.20	0.00	0.00	0.19	100
Upper SF A	10.89	5.30	0.49	1.55	69
Upper SF B	9.20	5.12	0.56	1.06	47
Upper SF C	3.07	0.19	0.06	0.56	89
Upper SF D	3.61	5.34	1.48	2.27	35
Upper SF E	3.29	2.18	0.66	0.99	33
Upper SF F	3.23	0.00	0.00	0.07	100
Upper SF G	1.34	0.00	0.00	0.00	0
Upper SF H	8.69	4.30	0.49	0.79	37
Upper SF I	4.84	4.08	0.84	1.03	18
Upper SF J	4.73	2.49	0.53	1.32	60
Upper SF K	1.24	1.71	1.38	1.45	5
Upper SF L	3.97	0.62	0.16	0.28	43
Upper SF M	5.62	1.38	0.25	0.25	0
Upper SF N	2.29	0.81	0.35	0.35	0
Upper SF O	1.66	0.04	0.02	0.02	0

Sediment measurements have not been conducted on the South Fork Stillaguamish in relation to development of a TMDL to manage sediment related issues in the watershed. While a TMDL has not been established for sediment, sedimentation in the South Fork Stillaguamish River has played a role in the degradation of habitat, geomorphic structure, and hydraulic function needed to maintain a diverse aquatic ecosystem. Sedimentation and temperature are directly tied in the ecosystem and the need to reduce sedimentation from roads and reduce numbers of road crossings was addressed in the Watershed Analyses (USDA Forest Service, 1995) (USDA Forest Service, 1996).

Riparian Reserves

The Northwest Forest Plan defined Riparian Reserves and established criteria for the size and distribution of buffers around aquatic and sensitive soil resources. Riparian Reserves within the project area watershed were modeled using GIS with a mix of existing data and aquatic surveys of the vegetation management units conducted in 2015 and 2016. A total of 5,779 acres of Riparian Reserves were determined as modeled to be located in the project area watershed (Figure 3).

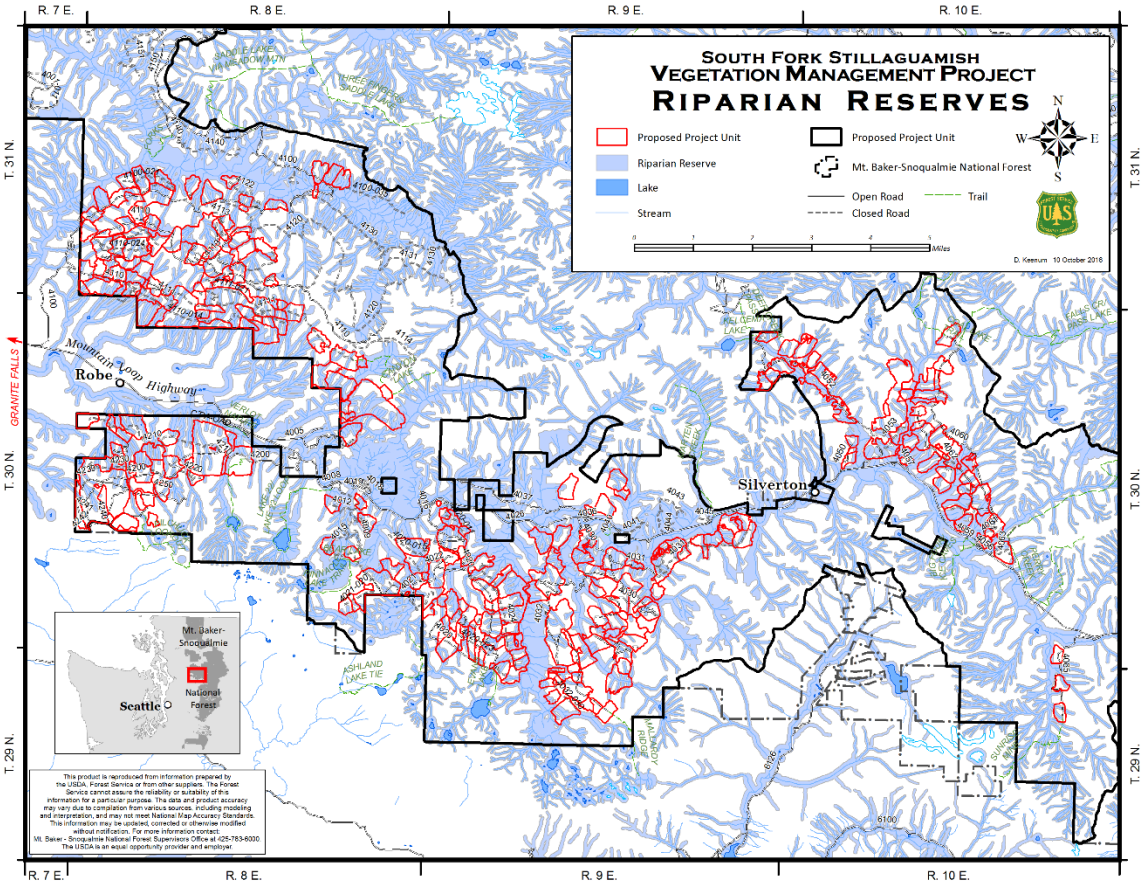


Figure 3. Riparian Reserves as modeled in development from aquatic resource surveys conducted in conjunction with the South Fork Stillaguamish River Vegetation Project.

Existing conditions within these riparian reserves are fairly consistent within all the proposed project units. These riparian areas within the proposed project stands are densely stocked, neither complex nor diverse (mostly dense stands of small Western Hemlock), lack riparian vegetation and structure, and would only achieve late-successional conditions "on their own" over a long period of time due to stocking levels. Desirable components of the stand, such as large-limbed, open-grown trees and diverse riparian vegetation and structure may not develop because of dense stocking levels. The dominant species in most stands is Western Hemlock. There is a need to develop a more "natural" mix of conifers and hardwoods as well as more diverse riparian vegetation and structure as appropriate. Achieving this condition within riparian areas would serve to better filter sediment and in the long run would better help with stream shading and stream temperature. Figure 4 is a picture of a riparian area within the proposed project stands. Figure 5 is located within the Lake 22 Research Natural Area (RNA), this photo displays a riparian area that has had no treatment over the years. This riparian area includes a diverse riparian plant population and structure, larger more diverse conifers, and large downed woody debris. Figure 5 represents an example of a desired future condition for the riparian areas within the project area.

Figure 4. Photo of a Typical Riparian Area (existing condition) within the proposed treatment stands. This photo was taken along an unnamed stream within proposed unit P28.

Figure 5. Photo of an unaltered riparian area (within the Lake 22 RNA) which is an example of a desired future condition for riparian areas within this project area.

9. Environmental Effects (includes Cumulative)

Areas of Concern

The direct and indirect effects of project alternatives were determined in relation to the following issues affecting hydrology and water resources:

- Water Quantity – Change in Peak/Base Flows
- Water Quality
    - Erosion and Sediment Delivery to streams
    - Stream Temperature
- Riparian Reserves
    - Wetlands
    - Diversity

The analyses of project alternative effects on these areas of concern are described below. Other relevant aquatic issues were analyzed and are expected to have no measurable impact from the project including stream network extension from roads. Such issues that would not be impacted by this project are municipal watersheds and floodplains. All proposed alternatives include avoidance measures to keep all timber harvest activities outside and away from floodplains. A discussion of expected effects to stream-adjacent areas and applicable mitigation measures is located in the Water Quality section on Erosion and Sediment Delivery to streams.

Water Quantity

The analysis area for direct and indirect effects on the water quantity is the project area watershed, more specifically the subwatersheds within the project area watershed that contain timber, road, or recreation site improvement work associated with this project. These subwatersheds include all of the 32 subwatersheds listed on Table 5. Although this project would generate log haul and heavy equipment hauling outside of the project area watershed on public and private roads, the effects of these activities on water quantity and peak flow increases are considered negligible and within the normal range of background levels.

Vegetation Disturbance & Peak Flow Increases

The Forest uses vegetation disturbance by as a surrogate measure for the risk of peak flow increases. Percent disturbance accounts for the effects of forest cover, soil compaction, and roads on runoff rates. Twelve percent vegetation disturbance is a threshold of concern used on the Forest to assess hydrologic conditions that may lead to increase erosion or increased peak flows from rain-on-snow storm events. Hydrologic maturity of stands is based on stand age with young stands (less than 25 years of age in the western hemlock zone) not having sufficient canopy to fully intercept precipitation in the rain-on-snow zone, and therefore contribute to a landscape more susceptible to rapid runoff and increased erosion potential. When areas are found to exceed this threshold, further detailed analysis based on site-scale information is needed to determine if the effects of vegetation disturbances would have a measurable impact on peak or base flows.

Current Condition

Currently, approximately 89 percent of the project area watershed is estimated to be in a hydrologically mature condition. In this context, hydrologically mature forest is defined as 60 percent or greater canopy closure and an average diameter at breast height of 8 inches or greater. With 11 percent of the watershed still remaining in a "disturbed" state and unable to provide a hydrologically mature forest cover, the snow accumulation, snowmelt, and runoff-generating dynamics are considered recovered following extensive timber harvest that occurred in the mid and late 1900's. Recognizing that disturbances are not evenly distributed through the watershed, subwatersheds were also analyzed for hydrological maturity. Two of these subwatersheds (Canyon Creek G and Lower South Fork) in the project area watershed were found to still be in exceedance of the twelve percent threshold (Table 5). Upon further investigation, the headwaters of these subwatersheds have endured extensive timber harvesting and road building. Canyon Creek G would recover to 11.5 in modeling year 2018. This subwatershed is within the project area, however there is no proposed activity scheduled to occur under the proposed action. The Forest has completed a number of road storage projects in this watershed under past activities which is contributing to the recovery in this watershed. Lower South Fork is a subwatershed almost entirely on private land and is just above the 12% level due to activities off forest. This subwatershed would recover to 11.9% in modeling year 2019. The majority of the project area subwatersheds as well as the project area watershed fall below the 12 percent threshold, and thus determined to be "Properly Functioning" under forest plan standards.

Direct and Indirect Effects

Alternative 1 - No Action Alternative

Current conditions would be maintained under the no action Alternative. In general, this area is maturing at a faster rate than harvest activities occur and has reached a level where past vegetation disturbance from harvest management is assumed to no longer have an effect on peak flow increases at the watershed scale in the project area watershed. Some subwatersheds are still in exceedance of the twelve percent threshold with site scale evidence in the form of geomorphic and vegetative conditions to support the model. Over time the hydrologic maturity of Forest Stands would continue to improve across the analysis area.

Alternative 2 - Proposed Action

At the watershed scale, implementation of the proposed harvest of trees under the proposed action in the South Fork Stillaguamish River Vegetation Project would have minimal change to the vegetation disturbance level in the project area watershed. At the subwatershed scale, treatments that would alter vegetation in hydrological immature subwatersheds were analyzed and altered to ensure that project activities result in minimal changes to peak or base flows within those subwatersheds.

Post-treatment canopy conditions in all of the thinning acres where trees would be removed are expected to be at or just below 60 percent which is the threshold considered

hydrologically mature. The recovery of vegetation from these treatments to hydrological maturity is considered to occur within a few years and is not considered to have an effect on peak or base flows.

The amount of disturbance would not cause the project area watershed to fall below the 12 percent threshold (Table 5). This is due to the proposed action including thinning and the rain on snow model being based off of clearcutting. Which, there is no clearcutting proposed under this project. Subwatershed scale analysis along with site scale analysis determined the amount of disturbance to vegetation due to thinning would be minimal to no effect on peak and base flow increases in project area tributaries where exceedance of 12 percent exists. This is due to the fact that the Lower South Fork subwatershed is the only subwatershed where work would occur in a subwatershed exceeding 12 percent, the fact that it is almost recovered to less than 12 percent (would recover to under 12 percent by 2019), and the fact that so little of the subwatershed would be affected by this project (0.8%). Streamflow and specifically peak and base flow increases in the South Fork Stillaguamish and tributaries are expected to be unaffected by the proposed action activities.

There are likely to be some local, site-scale effects on hydrology and snow interactions with the hydrologic cycle as a result of the proposed vegetation treatments. Additional snow is expected to accumulate on the ground as a result of decreased interception in the forest canopy in the thinned areas. Snowmelt may also be more rapid in the thinning units, as snowpacks have greater exposure to wind and other elements that cause snowmelt. In addition, the removal of vegetation by all treatment types would tend to allow increased soil moisture levels as a result of lower evapotranspiration. This can lead to the development of wetlands and wet areas which then may lead to changes in potential riparian vegetation distributions.

Canopy cover in thinned areas would be reduced to the lower limit for what is considered to provide hydrologically mature conditions ~60%. Variability in thinning may cause occasional small site specific openings however these are anticipated to recover quickly. The remaining trees in the thinned units and debris left on the ground from the thinning activities would provide sufficient interception to function as hydrologically mature even though at reduced rate for several years until the canopy is filled in. Recovery occurs quickly in these settings since only smaller, secondary trees would be removed as part of the thinning prescription and canopy closure occurs due to growth of additional limbs and branches with increased access to sunlight. These thinning treatments are not anticipated to reduce the effect of the forest to buffer peak and base flows even at the local scale compared to clearcut-type treatments not prescribed in this project and from road building activities.

Treatments proposed in creation of temp roads would remove the canopy and cause these areas to function in a hydrologically immature state until vegetation recovers. These areas would remain in a hydrologically immature state for at least 25 years within the western hemlock EcoZone and longer in the Pacific Silver Fir EcoZone before they would reach hydrologic maturity (Ketcheson, Leinenbach, Schuett-Hames, Whiley, & and James, 2003).

The overall, hydrologic effect of creating temporary roads is considered to be nearly immeasurable at both the project area watershed and subwatershed scales. While

likelihood that all of the proposed vegetation treatments would occur in the same year is very low, all treatments are considered to occur in the first year for modeling purposes and to demonstrate the greatest level of potential effects. In 2017 when the first vegetation and road treatments proposed for this project may occur, vegetation disturbance on the productive landscape would not see noticeable increase due to the low impact of the prescribed thinning treatments in the project area watershed (Table 6). At the watershed scale, treatments would not cause vegetation disturbances to result in changes to peak or base flows in the South Fork Stillaguamish River within and below the project area.

Table 6. Vegetation disturbance in the project area watershed and subwatersheds and recovery over the first three project years. Watershed and subwatersheds exceeding 12% are highlighted.

Watershed Name and project Area Subwatersheds	% Vegetation Disturbance in 2017	% Vegetation Disturbance in 2018	% Vegetation Disturbance in 2019
All Project area watersheds	4.7	4.5	4.2
Jim Creek C	3.8	3.5	3.4
Canyon Creek A	9.1	8.6	8.1
Canyon Creek B	4.9	4.6	4.4
Canyon Creek C	4.8	4.6	4.4
Canyon Creek D	10.5	9.9	9.3
Canyon Creek E	7.2	6.9	6.6
Canyon Creek F	0.7	0.7	0.6
Canyon Creek G	12.2	11.5	10.9
Canyon Creek H	0.3	0.3	0.3
Canyon Creek K	2.7	2.5	2.4
Lower South Fork	13.2	12.6	11.9
Lower South Fork A	4.7	4.4	4.2
Lower South Fork B	6.2	5.7	5.4
Lower South Fork C	11.2	10.6	10
Lower South Fork D	8.5	7.6	7.2
Lower South Fork E	5.2	4.6	4.4
Lower South Fork F	6.7	6.2	5.7
Upper South Fork A	2.6	2.5	2.4
Upper South Fork B	6.5	5.8	5.5
Upper South Fork C	1.2	1	0.8
Upper South Fork D	9.4	8.4	8
Upper South Fork E	3.5	3.1	2.9

Upper South Fork F	0.2	0.2	0.2
Upper South Fork G	0	0	0
Upper South Fork H	2	2	1.9
Upper South Fork I	3	2.9	2.8
Upper South Fork J	2.7	2.5	2.3
Upper South Fork K	2.6	2.5	2.5
Upper South Fork L	0.7	0.7	0.7
Upper South Fork M	0.7	0.7	0.7
Upper South Fork N	0.3	0.3	0.3
Upper South Fork O	0.04	0.04	0.04

Alternatives 2A and 2B

These alternatives would not be significantly different from Alternative 2. These alternatives would still occur over the same foot print. The only difference in vegetative disturbance would a reduction in acres treated (307 acres less for Alternative 2A and 89 acres less for Alternative 2B). Therefore, effects of these alternative on water quantity would be the same as those analyzed for Alternative 2.

Cumulative Effects

Table 9 outlines all of the past, present and reasonably foreseeable future projects that were considered for cumulative effects to peak flow increases. Past projects and current projects may have cumulative effects along with the proposed activities however no future projects have any bearing on water quantity in the analysis area for cumulative effects. No other thinning projects are identified in the foreseeable future on National Forest Lands in the South Fork Stillaguamish River Watershed.

Past projects have had cumulative effects within the project area watershed in the form of vegetation disturbances both permanent and temporary. The effects of these disturbances have caused changes in peak and base flows at the watershed scale that have taken decades to recover to the current hydrologically mature state where cumulative vegetation disturbances are below 12 percent. In this hydrologically mature state, further vegetation disturbances that do not cause an exceedance of 12 percent are within natural variability of conditions for peak and base flows. Over time, vegetation disturbances would continue to recover. Effects of this timber harvest in the project area watershed would not be discernible from existing 2017 conditions due to the low impact of the prescribed thinning treatments.

Past projects that still have lingering vegetative cumulative effects to water quantity include the past timber sales both on NFS lands and state and private lands downstream of the project area. The effect of these past projects has been incorporated into the results of the Rain on Snow model discussed above.

Project area subwatersheds are in various states of hydrologic maturity and due to past activities where the proposed activities would only cause minor changes within acceptable limits. These increases are expected to be most prevalent at the site scale near the thinning which could be mitigated by a thinning prescription that retains more trees

and canopy. However, the relative effect of all of all past, proposed, and future projects influencing vegetation is therefore not expected to have any measurable effect on peak flow increases at the watershed scale.

Water Quality

The analysis area for direct and indirect effects on the water quality is the South Fork Stillaguamish River and tributaries within the project area watershed and Subwatersheds that contain timber or road work associated with this project. These subwatersheds are Canyon Creek A and E, Lower South Fork, Lower South Fork A through F, Upper South Fork A through E, and Upper South Fork H through M (Figure 2). Although this project would generate log haul and heavy equipment hauling outside of these subwatersheds, the effects of these activities on stream temperature and erosion or sediment delivery to streams are considered negligible and within the normal range of background levels.

Erosion and Suspended Sediment/Turbidity

Sediment delivery from roads and management-related landslides has changed the natural sediment regime by increasing the amount of sediment that streams must process. Sediment from the road system can be delivered to streams by direct erosion of cut and fillslopes associated with stream crossings, or by surface runoff from roads and ditches that carries sediment-laden water directly or indirectly to streams. Not all sediment production from roadways reaches the aquatic system, because surface runoff from road surfaces and ditches is often directed to unchanneled slopes below the road where runoff has the potential to infiltrate the ground surface or the sediment settles out onto the forest floor before the water enters the streams.

Two factors affecting rates of sediment production from surface erosion on roads are road traffic levels and precipitation. Studies done on the Olympic Peninsula and in southwest Washington found that sediment production was increased by two orders of magnitude when comparing lightly trafficked and heavily trafficked forest roads during periods of runoff (Ried & Dunne, 1984) (Sullivan, Bilby, & Duncan, 1989). These studies also found that when traffic levels remained heavy during a runoff event, sediment concentrations in road drainage waters remained at a relatively high level throughout the storm.

Current Condition

The principal mechanisms for sediment delivery to streams from roads in the analysis area are surface gravel from exposed cut-and fill-slopes, side-cast and fill-slope failures, and undermining of roadbeds due to gully erosion associated with insufficient road prism drainage. Additionally, a lack of road maintenance has increased the risk of culvert failure, which could provide additional sediment delivery to streams. Unlike the composition of landslide sediments, finer materials including sand and silts are believed to dominate the largest fraction of sediments delivered via roads to stream channels.

Road densities in the project area watershed are between 0 and 1.68 miles per square mile of watershed in the affected subwatersheds (list of densities by subwatershed is located in Table 7) which is considered functioning properly (<2.0 mi/mi^2 is considered functioning properly) (National Marine Fisheries Service (NMFS), 1996). This is a significant reduction from the functioning at risk value of 2.87 mi/mi^2 determined to exist during the 1995 and 1996 watershed analyses. Reduction of road miles and stabilization of the remaining miles is important for reducing stream channel network extension, delivery of sediment, and improve peak and base flow conditions to the watersheds. Interception of shallow lateral soil water flow by road cuts and subsequent routing of that water into streams and rivers effectively increases drainage network density and peak flows and sediment delivery (Washington Forest Practices Board, 1997).

The existing road network contributes fine sediment sand-size and smaller throughout the year with the largest amounts probably being delivered during runoff events when the watershed is still accessible by motor vehicles. The watershed is relatively stable in terms of mass wasting at this time, but past failures were associated from land-management activities. Most of these failures have occurred in association with road systems failures and with the Gold Basin landslide that have left scars still visible decades later in the watershed. The volume of sediment actually delivered to the streams was augmented by road fill material from stream crossings and cross-slope roads. Additionally, roads that are no longer maintained may be at higher risk of more episodic failure due to inadequately maintained drainage structures. Sediment delivery from active channel migration is expected to naturally decrease as vegetation disturbances recover and a0s a result future restoration activities in South Fork Stillaguamish River watershed and associated Riparian Reserves.

Direct and Indirect Effects

Alternative 1 No Action Alternative

Existing road densities and erosion off of Forest Roads would continue into the future. Approximately 103 miles of the Forest System Roads would not receive maintenance including the placement of aggregate surfacing, ditch cleaning, or road reconstruction. Road decommissioning would not occur on 14 miles of system road and 73 miles of road would not be stored providing further protection of resources on those roads. The current road density at the watershed scale in the project area watershed of 1.7 would remain along. The existing mechanisms for sediment delivery to streams would continue unchanged, including existing rilling of road surfaces, imminent or future culvert failures, and traffic-related sediment inputs.

Alternative 2 Proposed Action

The only project activities that are expected to affect sediment delivery to streams are associated with road activities. Several types of road-related activities have the potential to effect sediment production in this project, specifically:

- Log Haul
- Road Treatments
    - Road maintenance and improvements

- Temporary road construction
- Post-harvest Road Closure and Decommissioning

No new permanent roads would be constructed under this project, but several temporary features would be needed to provide effective access to project areas, including temporary roads.

The proposed harvest-related activities associated with tree cutting and removal (felling, bunching, and yarding) are not expected to have any impacts to streams from sediment delivery.

Table 7. Road densities within the project area watershed and subwatersheds.

Subwatershed	Subwatershed Area (mi^2)	Existing (No Action)		S. Fk. Stillaguamish Road density (1995) (mi/mi^2)	% Reduction in Road Density since 1995	Proposed Action		
		Existing Road Length (mi)	Existing Road density (mi/mi^2)			Road Length (mi)	Road Density (mi/mi^2)	% Reduction in Road Density from Existing
Jim Creek C*	5.68	0.41	0.07	0.20	64	0.41	0.07	0
Canyon Creek A	9.42	4.74	0.50	0.69	27	4.74	0.50	0
Canyon Creek B*	4.57	4.62	1.01	1.45	30	4.62	1.01	0
Canyon Creek C*	3.56	5.02	1.41	2.23	37	5.02	1.41	0
Canyon Creek D*	7.17	5.06	0.71	0.86	18	5.06	0.71	0
Canyon Creek E	9.16	12.52	1.37	2.87	52	9.09	0.99	27
Canyon Creek F*	2.29	1.04	0.46	0.61	25	1.04	0.46	0
Canyon Creek G*	3.76	0.94	0.25	2.58	90	0.00	0.00	100
Canyon Creek H*	1.02	0.00	0.00	0.22	100	0.00	0.00	0
Canyon Creek K*	4.13	0.00	0.00	0.15	100	0.00	0.00	0
Lower SF	34.44	1.75	0.05	0.06	11	0.11	0.00	94
Lower SF A	23.47	19.53	0.83	1.58	47	13.57	0.58	31
Lower SF B	4.77	6.06	1.27	2.46	48	6.06	1.27	0
Lower SF C	2.95	4.97	1.68	2.79	40	3.20	1.08	36
Lower SF D	2.13	0.32	0.15	1.97	92	0.13	0.06	61
Lower SF E	4.77	2.06	0.43	0.86	50	2.06	0.43	0
Lower SF F	3.20	0.00	0.00	0.19	100	0.00	0.00	0
Upper SF A	10.89	5.30	0.49	1.55	69	5.30	0.49	0
Upper SF B	9.20	5.12	0.56	1.06	47	3.63	0.39	29
Upper SF C	3.07	0.19	0.06	0.56	89	0.19	0.06	0
Upper SF D	3.61	5.34	1.48	2.27	35	5.34	1.48	0

Upper SF E	3.29	2.18	0.66	0.99	33	2.18	0.66	0
Upper SF F*	3.23	0.00	0.00	0.07	100	0.00	0.00	0
Upper SF G*	1.34	0.00	0.00	0.00	0	0.00	0.00	0
Upper SF H	8.69	4.30	0.49	0.79	37	2.72	0.31	37
Upper SF I	4.84	4.08	0.84	1.03	18	3.59	0.74	12
Upper SF J	4.73	2.49	0.53	1.32	60	1.99	0.42	20
Upper SF K	1.24	1.71	1.38	1.45	5	1.06	0.85	38
Upper SF L	3.97	0.62	0.16	0.28	43	0.62	0.16	0
Upper SF M	5.62	1.38	0.25	0.25	0	0.87	0.16	37
Upper SF N*	2.29	0.81	0.35	0.35	0	0.81	0.35	0
Upper SF O*	1.66	0.04	0.02	0.02	0	0.04	0.02	0
Total (All project subwatershed)	194.15	101.38	0.52	1.02	49	83.46	0.43	18

* No proposed timber harvesting under this project exist within these subwatersheds. These subwatersheds are located upstream of subwatersheds with proposed harvesting.

Log Haul Routes

Approximately 190 miles of FS road would be used for this project under the action alternatives. Primary haul routes for this project would be Forest Roads 4020, 4021, 4030, 4031, 4032, 4052, 4060, 4062, 4065, 41, 4110, 42, and 4250 along with some combination of arterial and local roads. Upon leaving Forest Service roads, haul routes are expected to go west on the Mountain Loop Highway.

In general, roads lacking surface rock, those with steep grades and steep sideslopes, and those that cross streams or are in proximity to streams are the greatest contributors of sediment from surface erosion. The majority of the haul route on the national forest are unpaved, gravel or native surface roads. Because many of the roads in the vicinity of this project are poorly surfaced, and are in many cases directly linked to the stream network through roadside ditch drainage, timing of haul for this project would be limited to the summer months and during appropriately dry periods to reduce rates of sediment introduction to South Fork Stillaguamish River and other tributaries (see Mitigation/BMP section of this report).

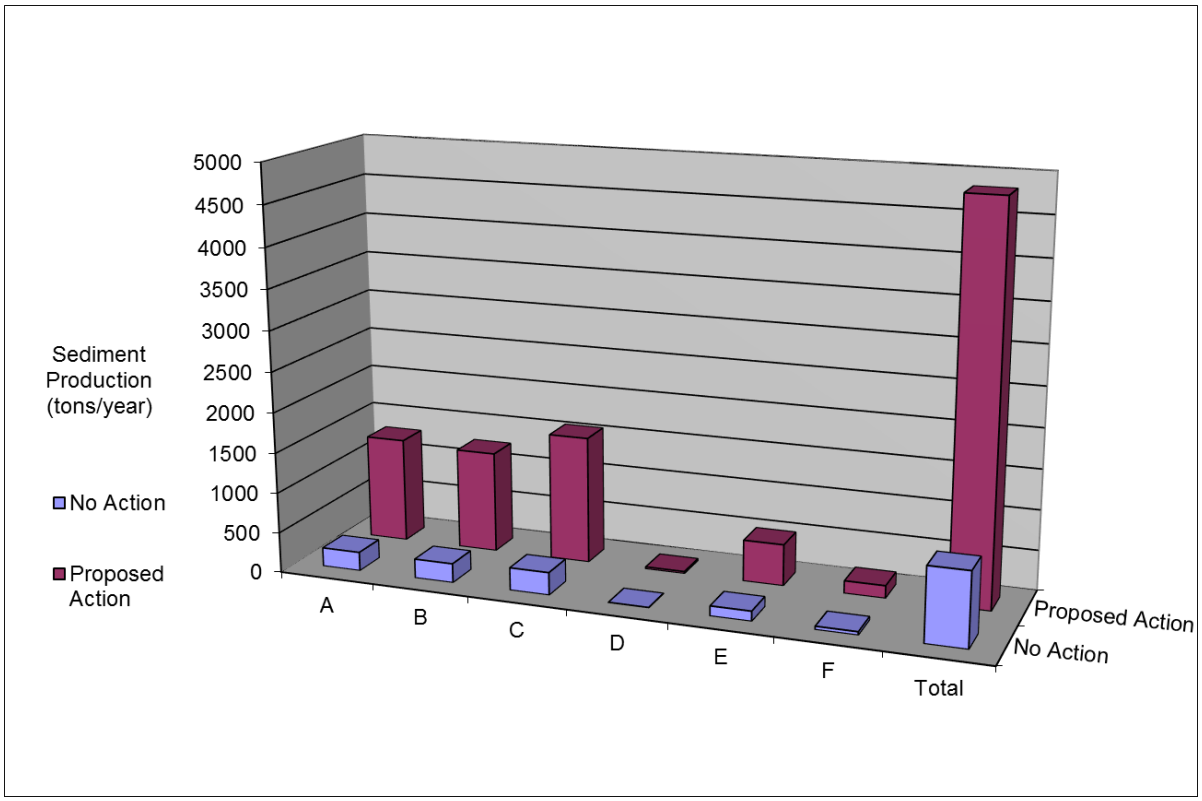
Simple sediment transport rates were applied to model an estimate for the rates of sediment delivery to streams from haul routes of the South Fork Stillaguamish River Vegetation Project. For these model runs it was assumed that the cut and fillslopes are 50% vegetated, that all gravel roads had only 2-6 inches of gravel surfacing, that annual precipitation was 47 inches or more, and that log haul from this project was concentrated to a six month period with only light to moderate traffic on the roads for the balance of the year. Closed roads were considered to have no traffic. This model run using the affected HUC 6 watersheds labeled under Table 4.

Once ditch flow begins to occur, suspended sediment concentrations in receiving streams can increase by over an order of magnitude as a result of the possibility of introduction of turbid ditch flow water to the stream. As this material travels downstream, the concentrations are likely to decline at some unknown rate due to dilution from other contributing streams that are not impacted by the road runoff. In valley bottom streams that typically support a majority of the fish in this system, turbidity and suspended sediment levels are likely to be lower due to the greater opportunity for significant dilution and deposition in those areas.

The amount of sediment that is delivered as a result of log haul to these lower reaches is expected to be below background levels and not measurable, since the natural background suspended sediment levels in drainages such as the South Fork Stillaguamish can be high. For example, Nelson (1971) estimated the suspended sediment loading at the Garcia gage to be approximately 21,000 tons, which has been supported by calculations from other studies such as Dunne (1984). Suspended sediment production rates from these studies indicate approximately 25,000 to 35,000 tons of suspended sediment would be produced from the project area watershed on an annual basis.

Results of the modeling suggests that sediment delivery to aquatic systems from the haul route ranges from up to 914 tons/year under the No Action due to current vehicle traffic to over 4834 tons/year under Proposed Action where all proposed activities would occur. The relative distribution of sediment delivery from the South Fork Stillaguamish River Vegetation Project amongst the HUC 6 watersheds and project area watershed as a whole is illustrated in Figure 5.

Figure 5. Estimated sediment delivery from haul routes within the project area watershed and HUC 6 watersheds*.



*HUC 6 Watersheds are labeled on figure 5 as follows: A. Upper South Fork Stillaguamish River, B. North and South Fork Canyon Creek, C. Middle South Fork Stillaguamish River, D. Jim Creek, E. Headwaters of South Fork Stillaguamish River, and F. Canyon Creek.

Under all alternatives, the watersheds Upper South Fork Stillaguamish River, Middle South Fork Stillaguamish River, and North and South Fork Canyon Creek would likely experience the greatest amount of increased sediment delivery as a result of haul activities. These watersheds appear to have a disproportional amount of sediment from roads however there are several considerations for this. These modeling results are for haul roads only and a majority of this project occurs in those watersheds. Although these figures fit into the range of sediment production values found in the literature, they are considered extremely rough estimates due to the limited data on specific conditions of the various roads and variability in traffic levels from haul during operations. The results are primarily provided to allow comparisons of relative sediment production rates between alternatives. More accurate estimates of sediment production and delivery would require much more extensive information on road surfacing, drainage frequency, and distance between road drains and streams.

Sediment transport as described above leads to increases in turbidity and suspended sediment in receiving surface waters. Since most of the roads in the planning area have active inboard ditches, these channels form the avenue for routing this sediment to streams. Suspended sediment concentrations in ditch flow have been measured at 500 to 7,000 mg/l and as high as 20,000 mg/l during active hauling in a study completed in the western Cascades of Washington

State (Bilby, Sullivan, & and Duncan, 1989). Ditches are drained at some spacing along roads by either ditch relief culverts or live streams. Some portion of the ditch relief culverts do not deliver sediment to the stream system because they discharge to unchanneled slopes where water can infiltrate the ground surface and/or sediment can be filtered and dropped out of suspension. There is no measure of the number of culverts in this planning area that deliver to streams or that discharge to forested slopes, but it is likely that the proportion would change based on the intensity and duration of the runoff event.

The increase in sediment produced from log haul, at a maximum of 3920 tons/year for proposed action would be dispersed across all 6 HUC 6 watersheds. The estimated 3920 tons relative to the rates from the studies for rates from the watershed suggest that haul may increase sediment which would not be measurable or discernable at the watershed scale and is considered to be within the natural variability of these rates.

Road Treatments

The road treatments proposed in the proposed action have the potential to affect the erosion potential to streams during both the construction-related activities and into the future. The proposed road treatments within this project are either road maintenance or improvements associated with the thinning of units or with road restoration work to reduce impacts to soils and the aquatic environment.

Road Maintenance and Improvements

Prior to hauling, portions of the Forest Service System road network (system roads) would be treated to repair and improve drainage structures, improve the running surface of the road, and to clear vegetation along roadsides (daylighting). Following haul, portions of the haul route would again be treated to repair damage done during logging and to restore the roads to a condition that supports normal forest uses and to ensure proper drainage and stability of the roads. Portions of the haul route that are in particularly poor condition would be reconstructed prior to haul activities. Road reconstruction includes application of surface rock, replacing damaged or poorly functioning culverts, adding stream-crossing or ditch relief culverts where necessary, some road widening, and removing roadside vegetation that is encroaching on the road surface and preventing vehicular passage. Nearly all of the system haul routes would require a mix of maintenance, reconstruction activities, and daylighting to bring the roads up to standard for haul. No new permanent road construction would occur under this project.

Planned road maintenance activities for the proposed action include adding road surfacing, removing roadside vegetation, clearing plugged culverts, and reestablishing ditch drainage on approximately 103 miles of permanent system road. The application of additional gravel for road surfacing would reduce the availability of fine sediment to be transported off of the road system during haul activities and into the future. Upon completion of the project, these roads would continue to be managed in their current status open to public use. Beyond general road maintenance and surfacing treatments, heavy reconstruction would improve access along approximately 103 miles of road, replace stream and ditch relief culverts, and improve road-drainage by rebuilding ditch lines and road surfaces.

This more intensive road work that occurs under reconstruction can have a long-term improvement to the road drainage network. Upon completion of the project, public road use would continue as it is now however with the road improvements in place. Through reconstruction activities on system road haul routes, a total of 11 stream crossing culverts would be replaced and improved for aquatic organism passage and capacity to meet the forest standard for crossings to pass the 100 year flow plus debris.

Several roads would be placed into storage upon completion of project activities. The project would improve the operational condition and reduce aquatic risk of these roads closed to the public. Infrastructure on these roads such as ditch drainage and stream crossings installed to establish appropriate conditions for haul would be removed upon completion of the project. Preexisting infrastructure not replaced by the project would be left in place until treatments can be funded through existing processes.

Some heavy reconstruction activities would be undertaken solely for the benefit of the proposed vegetation treatment and may even create short term degradation of water or soil resources. In the long term, these activities from general maintenance to reconstruction bring these roads back into appropriate operating condition for public use.

Temporary Road Construction

A total of approximately 23.4 miles of temporary road would be needed to enable harvest activities in Proposed Action. Of these 23.4 miles, approximately 1.8 miles of new temporary road construction would be needed but very little of this road construction would occur on undisturbed soil. Nearly all of the temporary roads in this project, including those newly constructed, follow past road features, but not all of them have been effectively restored to natural conditions. Temporary Road Reconstruction would occur on 28 miles of road that is either no longer in use and in a state of natural recovery or exist in a condition with drainage related issues. Use of such features in this project would ensure these old road beds and features receive effective restoration, so that they do not have lingering aquatic risk or detrimental effects to the landscape. Table 8 summarizes temporary road construction proposed within the South Fork Stillaguamish River Vegetation Project and their relative location in relation to Riparian Reserves.

Table 8. Summary of temporary road construction proposed within the South Fork Stillaguamish River Vegetation Project. (Lengths are approximations as calculated from GIS)

Temporary Road Activities	Temporary Stream Crossings	Temporary Road Construction Activity	Proposed Action (Miles)
New Temporary Road Construction	3	Within Riparian Reserve	0.5
		Within aquatic nocut	0.02

		Outside Riparian Reserve	0.9
Temporary Road Reconstruction	190	Within Riparian Reserve	39.8
		Within aquatic nocut	1.08
		Outside Riparian Reserve	18.4
Total Stream Crossings	**193**	**----**	**--**
Total Temp Road Construction/Reconstruction (miles)		Within Riparian Reserve	40.3
		Within aquatic nocut	1.1
		Outside Riparian Reserve	19.3

Additionally, temporary stream crossings on any roads have the potential to affect site-scale impacts to aquatic systems by manipulating streambank vegetation and natural morphology. All aquatic risk and other road drainage related issues on these roads would be stabilized upon completion of the project.

New temporary road construction is expected to have the greatest effect on soil quality and productivity, while new temporary road construction within the riparian reserve has the highest potential to effect sediment production and potential delivery to streams. Approximately 0.5 miles of new temporary road would be constructed within the riparian reserves. Up to 3 temporary stream crossings would be installed on new constructed temporary roads where location of these roads has been scrutinized to minimize stream crossings and avoid wetlands entirely. While effects to aquatic resources may not be as great as with new construction, reconstruction of 23.4 miles of road would occur along with 190 temporary stream culverts within Riparian Reserves. Construction of stream crossings would require some excavation of stream material, placement of a new pipe, and replacement of fill material. Some direct excavation within the channel would need to occur to provide an adequate size and condition of the bed prior to laying new pipe.

Most of the temporary roads are located on currently existing roadbeds of either old non-system haul routes or otherwise unclassified roads that were never part of the official Forest Service road system. The reuse of these roads would enable proper restoration of the road bed with decompaction and revegetation techniques upon completion of use. If in use more than one season, temporary roads would be weatherized prior to the onset of wet weather in the fall.

Following completion of harvest, all temporary roads and skid trails would be treated. Timber Sale contracting limits the removal of temporary road infrastructure to that which was installed to gain access. Treatments to temporary roads upon completion of work would include out-sloping, sub-soiling to a depth of approximately 18 inches to reduce ground compaction (in areas where greater than 60 feet of continuous soil compaction or displacement as identified by 6-inch deep ruts has occurred), seeded, and covered with mulch or slash. Native seed or appropriate weed abatement seed mix will be applied, as described in mitigation measures. Prior to any expected seasonal period of precipitation and runoff, and after sale activities are complete, cross drains and grade breaks would be installed on all temporary roads and skid trails. In special cases (i.e. stream crossings, contributing areas near streams, or other sensitive areas along existing roads), mulch, erosion matting or re-contouring may be used as needed to prevent or reduce erosion and risk of sediment delivery. The expectation of this treatment includes the maintenance of soil permeability and soil productivity, and the near-elimination of increased channelization of surface flows in harvest units near streams originating from temporary roads and harvest related activities.

The Proposed Action would replace and bring up to forest standards 11 stream crossings on a combination of system and non-system haul route roads in the project area. Although best management practices would be used to minimize the actual sediment introduced to streams (see Mitigation Measures), there is no way to completely avoid sediment introduction and disturbances of the stream channel in the process of constructing new roads, reconstructing roads in existing corridors, and while installing or removing culverts. Along constructed and reconstructed roadways, erosion and potential sediment delivery would likely occur during runoff generating events. As transportable material is removed from the disturbed sites, the turbidity levels would increase in the short term then decrease rapidly to near pre-project levels. These effects would be relatively short term pulses of increased turbidity and sediment movement into project area tributaries and South Fork Stillaguamish River under the Proposed Action.

Road Storage and Decommission

Road Storage and decommissioning activities would occur under the Proposed Action. The continued use and existence of roadway segments provides a continued risk of culvert failures, erosion, cut and fill slope failure, and sediment delivery to receiving waters. The only way to completely eliminate this risk to aquatic resources is to store or decommission road segments.

Road storage and decommissioning would eliminate the long-term risk of sediment production in streams from roads and road-side ditches, particularly through these processes:

- Reduce sediment delivery from future culvert failures, landslides, and road failures.
- Reduce sediment delivery to streams due to road use by vehicular traffic.
- Reduce sediment delivery to streams by suspension of sediment in overland flow and delivery to streams.
- Reduce sediment delivery to streams by improving infiltration of water into the ground through de-compaction of road soils.
- Reduce sediment transport in ditches and delivery to streams by filling in ditches and out-sloping road surfaces.

Heavy equipment excavation is used to remove and install culverts, create waterbars, and decompact the roadbed for which this excavation would be the primary sediment producing activity during the road upgrade and decommissioning/storing activities. The proposed action could use any of the activities listed on Table 1. Minor amounts of fine sediment would likely be delivered to aquatic resources during implementation of road treatment activities and during the first substantial runoff event. Subsequent runoff events would contribute less sediment production over time but are expected to last up to several years while surface sealing occurs or until vegetation is established on bare-soil areas adjacent to streams (Madej, 2001). Design criteria and Best Management Practices would be used to minimize the amount of fine sediment entering stream channels while work is in progress and after the work is completed, including promoting vegetation establishment through seeding.

Sediment delivery to streams is expected to occur during road decommissioning/storing activities when:

- Culverts and fill material around culverts are removed and areas around culverts are regraded to natural stream contours on decommissioned and stored road segments, and
- During construction to replace culverts and stabilize upgraded road segments.

Of course, the amount of sediment delivered to streams is expected to be significantly less than would occur if the roads were left under current maintenance and even less in the case of a culvert failure. Without the means to conduct annual road maintenance the potential for culvert failures goes up with time and can only be eliminated by removal. Cook and Dresser found that stream-crossings that were restored through decommissioning delivered only 3 to 5 percent of the amount of fill material that was originally located at each crossing (Cook, 2004).

The proposed action would decommission 11 miles of system road and place an additional 17 miles of system road into storage. These treatments are expected to cause minor amounts of sediment to enter streams during road treatment activities, and minor amounts of sediment are also expected to be produced during the first substantial rainfall-runoff event following construction. Best Management Practices would minimize the amount of sediment entering streams while work is in progress and after work is completed, such as promoting vegetation establishment on all disturbed areas after work has been completed by applying a mix of native, weed-free seed. Hay or mulch will also be distributed with the seed to disrupt rain splash erosion, retain moisture, and enable seed establishment and growth.

The amount of sediment that these excavation activities would produce in conjunction with sediment from haul routes is expected to be within the normal range of variability occurring within project area streams and rivers. Thus, the potential sediment delivery to local stream and river systems is considered insufficient to change channel geomorphology or current trends in geomorphology. Overall, the proposed action is expected to provide a decrease in stream turbidity in project area streams, as well as an improvement of bedload size distribution and channel morphology over the long term.

Alternatives 2A and 2B

These alternatives would not be significantly different from Alternative 2. These alternatives would still occur over the same foot print. The only difference in vegetative disturbance would a reduction in acres treated (307 acres less for Alternative 2A and 89 acres less for Alternative 2B). The only road changes between Alternative 2 and 2A/2B is the estimated increase of new

temporary roads within the project area of 3 to 5 miles and a reduction in reconstruction of previous temporary roads that would be not be used. New road construction would be in the vicinity (sub-drainages) of the reconstructed temporary roads displayed in Alternative 2. All new temporary roads would be decommissioned following use. Therefore, any changes to effects of water quality would be the similar as those analyzed for Alternative 2.

Cumulative Effects

Table 9 outlines all of the past, present and future projects that were considered for cumulative effects on water quality within the project area watershed. Past land management activities on and off forest lands have had cumulative effects to water quality in the South Fork Stillaguamish Watershed. Past projects such Vegetation management Projects have generated sediment and vegetation disturbances that are considered to have largely recovered or no longer effectively augment natural processes. Implementation of road storage and decommissioning as well as road to trail projects is likely to continue in the foreseeable future. These road mile reductions have been critical in bringing the road densities and the stream network extension back into reasonable values. The recovery of vegetation disturbances as tracked since 1900 on forest lands has recovered to within the 12 percent threshold for acceptable augmentation of peak and base flows. The South Fork Stillaguamish River Vegetation Project would not cause exceedance of this cumulative threshold and would not prevent continued recovery of past vegetation disturbances. Recreation and other future projects in the watershed would be designed so they would not cause any changes in runoff or sediment regimes in local tributaries let alone in the South Fork Stillaguamish River. The project would reduce aquatic risk and ongoing erosion and sedimentation through maintenance and improvements along haul routes which are currently not sufficiently maintained and are in different states of disrepair. The proposed action would support continuing the long term trend in reduction in sediment and network extension through road treatments.

Stream Temperature

Current Condition

A stream channels ability to maintain stream temperatures is directly coupled with stream channel geomorphology. Elevated sediment regimes can overwhelm a stream channels capacity to carry sediment resulting in loss of pool volume, instigation of channel widening along with shortening of the water column and subsequent increased stream tempertures. As discussed above, sediment production from the project is anticipated to be within the natural variabiltiy of the South Fork Stillaguamish and would not cause changes to channel geomorphology. Thus, any sediment delivery as a result of this project is not anticipated to have any effect on temperature through geomorphic influences.

Shading of the stream and river channels in the project area by way of riparian vegetation is highly variable. Along many of the project area streams, near channel riparian vegetation including hardwoods and shrubs that provide shading and other functions to the ecohydrology of these stream corridors and lacking or nonexistant. Past harvesting has left stands so dense that insolation has been insuffecient to support riparian vegetation. Thinning adjacent to these areas

would hopefully release the hardwoods and other shade producing riparian species. (Press, 2014) found that similar thinning under the NWFP that have monitored this desired response in the near channel shade producing riaparian vegetation found that even though there was a response, the goal to improve growth was not fully met. This was attributed to not thinning enough in the adjacent stands to stimulate this response and recommendation included completely remove or girdle trees in the nocut buffer. While this project would not be treating trees in the nocut buffer areas, any increase in insolation and growth response along project area tributaies would be benificial to ecohydrologic function of the riparian reserves as a whole. Along the South Fork Stillaguamish River, riaparian vegetaion is slowly recovering from past activites is helping to increase bank stability and reverse historic channel widening.

Direct and Indirect Effects

Alternative 1 - No Action Alternative

The no action alternative would have no direct effect on water temperature within or downstream of the project. Since no treatments would be employed on proposed thinning units or roads under the no action alternative, stream temperature reductions may continue into the future as vegetation reaches maturity, but these reductions would occur at a slower rate than the proposed action. The proposed thinning would accelerate the growth of trees within the riparian reserves, which have some potential to eventually be deposited in streams and provide large wood debris and pool-forming habitat that would reduce stream temperatures. Without thinning riparian reserve areas, these trees are expected to be constrained by competition and not grow as large before they die. Thus, the no action alternative would indirectly inhibit the future input of large wood debris to streams within the project area, as well as prevent reduction of current road-related sediment inputs that affect channel dimensions and the effectiveness of solar inputs on heating the water column.

Alternative 2 - Proposed Action

Water temperatures would not be directly affected by this project because shade producing vegetation would not be cut on streams and sediment delivery is not anticipated to have an effect on channel geomorphology. Sediment from the project would not increase stream width, which can have the potential to increase stream temperatures by decreasing water column depth. No effects are expected on any 303(d) listed water courses due to the distance of project elements to these listed stream courses, as well as application of project design criteria and mitigation measures as part of project activities.

No thinning would occur in close proximity to streams. No-cut buffers have been prescribed on all streams, ponds, and wetlands to protect existing shade-producing trees from being cut. Minimum no cut buffers were defined at varying distances based on site specific conditions including channel migration zone, hillslope stability, and stream type. A minimum 100 foot no cut buffer from the channel edge of Fish Barring streams was applied, this included the South Fork Stillaguamish River. Site specific conditions exclude harvesting activities include the channel migration zone and steep facet slopes over the South Fork Stillaguamish River.

All other stream no-cut buffers would be measured back from the greater of the top of slope break or from the streambank where no obvious slope break exists. Minimum no cut distances of

100 feet to all fish-bearing streams and 30 feet from all non-fish bearing perennial streams and wet-areas/seeps and 15 feet from all non-fish bearing intermittent streams as measured from the stream bank or back from the top of the slope break whichever is greater. The retention of all stream adjacent vegetation as well as everything within 100/30/15 feet of the top of the slope break is to retain all vegetation within the current primary shade zone.

The intent of these no-cut zones is to protect all vegetation on hillslopes adjacent to streams, including all understory and tree species, and to retain sufficient shade to prevent solar heating of the stream. Wilkerson et al. (Wilkerson, Hagan, Siegal, & Whitman, 2006) found that 75 foot buffers with 60 % canopy closure on both sides of the stream resulted in no detectable water temperature change. Groom et al. (Groom, Dent, & and Madsen, 2011) detected no difference in pre- and post-harvest stream temperatures on Oregon state forests using a 100 foot riparian management zone limited to thinning, with a 25 foot no cut buffer. Anderson and Poage (Anderson, 2014) in a studied variable buffer widths associated with harvesting timber with implementation of NWFP and the effects of these buffers on stream temperature in western Washington and Oregon. Anderson and Poage (Anderson, 2014) found that with a minimum 50 ft variable buffer width, slight air temperature increases were measured in the microclimate over streams however these increases were not sufficient to have an effect on stream temperatures. While the canopy density directly over the stream would not be affected, the angular canopy density (ACD) would be reduced thus increasing solar radiation input to the stream.

Reeves et al. (Reeves, Burnett, & and McGarry, 2003) found that over half the large wood in a stream was recruited from upslope. Upslope wood recruitment would be protected by prohibiting harvest on inner gorges and unstable ground. Additions of large wood require that large trees are present to fall into the channel however. The thinning of upslope and riparian areas would allow for the remaining trees to grow larger and potentially provide larger wood debris to streams in the future than would occur otherwise. Thus, thinning in these areas could have an indirect effect on stream temperature if those trees are recruited to the stream.

The minimum no-cut distances to be used on perennial streams in this project are also consistent with the Northwest Forest Plan TMDL for Western Washington National Forests that is currently in development with the EPA (Enviromental Protection Agency, 2012). This "Westside TMDL" will define minimum no-cut distances to ensure that no trees are cut within the current primary shade zones, which vary in size or width from the stream based on stream width, riparian tree height, slope of the adjacent hillslope, and solar aspect or stream orientation in relation to the sun.

Alternatives 2A and 2B

These alternatives would not be significantly different from Alternative 2. These alternatives would still occur over the same foot print, including the same riparian areas. The only difference in vegetative disturbance would a reduction in acres treated (307 acres less for Alternative 2A and 89 acres less for Alternative 2B). Therefore, effects on stream temperature would be the same as those analyzed for Alternative 2.

Cumulative Effects

The affected area for cumulative effects to the stream temperature is confined to the subwatersheds where this project is located and the South Fork Stillaguamish River downstream

of the project. Project activities are not anticipated to have an effect on stream temperatures in tributaries and thus will have no effect on current or future water temperatures downstream of the project. Historic land management in the area has had effects on water temperatures resulting in the measured excursions beyond criteria for healthy systems. No cumulative effects are associated with past projects including the South Fork Stillaguamish Thin where vegetation harvesting because they were designed to minimize effects to water quality with BMPs and mitigation measures protecting stream temperatures and minimizing sediment. These projects utilized large riparian buffers with little potential to change stream temperatures during the project or after and thus no cumulative effects are associated with them. Stream temperature is not expected to be affected by any of the on-going or future projects in the project area subwatersheds, since no stream-side clearings or in-stream work is proposed in any of these projects. All Action Alternatives are not anticipated to have cumulative effects to stream temperatures as the project by design and best management practices protect stream conditions that maintain stream temperatures.

Riparian Reserves

The analysis area for direct and indirect effects to the Riparian Reserves includes the Riparian Reserves within project area watershed and subwatersheds where project related timber harvesting and or road work would occur. While Riparian Reserves exist beyond these locations in the project area watershed and subwatersheds, this analysis area was focused on identifying direct impacts to the condition of the Riparian Reserves and the wetlands they protect.

National Wetland Inventories and National Hydrography Dataset stream inventories, Washington State Department of Fish and Game stream layer and the USDA Forest Service stream layer were reviewed for initial distribution of aquatic resources in the initially proposed timber harvest units. To ensure aquatic resources are identified, and protected, field surveys were then performed during 2015 and 2016. Surveys included all proposed vegetation management units and all roads where work would be performed under this project, as well as the areas within 100 feet of these locations. These areas were visited by hydrologists, botanists, and soil scientists for the proper identification of streams, seeps, springs, wet areas, hydrophilic vegetation, hydric soils, and wetlands. All identified features were mapped using field GPS techniques and subsequently digitized into GIS to ensure they were tracked and integrated into the proposal for vegetation management activities. The proposed ground disturbing work could result in the loss of riparian and ecohydraulic functions to support Riparian Dependent Resources.

Wetlands are an important and sensitive resource within the riparian reserves that have potential for impacts from project related activities. The analysis focuses on wetlands and waters of the US that may be affected by this project and may trigger permitting requirements under the Clean Water Act. The Northwest Forest Plan recognizes the value and function of wetlands and requires protections for both regulatory and non-regulatory wetlands under the Aquatic Conservation Strategy (USDA Forest Service and USDI Bureau of Land Management, 1994).

The Riparian Reserves were designed in the NWFP to include and protect a diverse suite of aquatic and soil resources that provide conditions and a vast array of biological and ecohydrologic functions within a forest ecosystem. Diversity within the Riparian Reserves encompasses a variety of conditions in the vegetation that provide habitat for biota from dense to

open, young to old, and from wet to dry in soils that together provide the refugia and micro environments for a diverse forest ecosystem to thrive. To provide the diversity necessary for a healthy riparian and forest ecosystem, variable conditions in the stand and near channel riparian vegetation must exist. Openings to provide light sufficient to allow near channel and shade producing vegetation to grow and cycle nutrients.

Current Condition

Approximately 5,779 acres of Riparian Reserves (46% of project area) were modeled to exist within the project area watershed and subwatersheds. A combination of data from field surveys and the Forest Service corporate stream layer were used to model the Riparian Reserves following criteria set by the NWFP (USDA Forest Service and USDI Bureau of Land Management, 1994). Field surveys conducted in 2015 and 2016 identified and mapped approximately 140 miles of seeps and stream channels in or immediately adjacent to project proposed harvest units and haul routes. Surveys also identified approximately 220 acres of wet areas where one or a combination of saturated soils, hydric soils, hydrophilic vegetation, ponding, springs seeps, and wetlands may be present. It is expected that all of these areas could be classified using the USFWS wetland classification system (Cowardin, Carter, & Golet, 1979), but that only a small portion of these wet areas would be considered regulatory or "jurisdictional wetlands" as described by the 1987 US Army Corps Wetland Delineation Manual and more specifically the Western Mountains, Valleys, and Coast Regional Supplement to the Corps of Engineers Wetland Delineation Manual (U.S. Army Corps of Engineers, 2010). Some of these areas may not be eligible for jurisdictional wetland status however these areas of wet soils and hydric vegetation are managed as though they are wetlands in this project and protected by avoidance and project activities around them are limited by Standard and Guidelines regarding Riparian Reserves in the NWFP (USDA Forest Service and USDI Bureau of Land Management, 1994). Thus, the Riparian Reserves distribution is well known within and adjacent to the project harvest units allowing for analysis of effects.

Direct and Indirect Effects

Alternative 1 - No Action Alternative

The No Action Alternative would have no effects on Riparian Reserves including wetlands within the project area, since no work would be performed in, near, or adjacent to these areas. The existing Riparian Reserve area would continue to evolve and recover from past harvesting activities and existing wetlands would continue to develop over time but at a very slow pace. Without creating openings and changing the insolation regimes around many of the tributary corridors, near channel riparian vegetation would continue to be limited until dense stands partly die creating openings in the canopy and increasing Riparian Reserve diversity.

Alternative 2 - Proposed Action

All 220 acres of wet areas that were identified in the field have been reviewed and buffered from project activities proposed under the proposed action alternative. These wet areas would not be impacted by project work as a result of total avoidance and the application of mitigation and best management measures in adjacent areas to protect them from indirect effects. Any additional

wet areas found during layout would also be buffered to exclude any work or equipment to ensure no impacts occur to the vegetation, soil, or hydrologic flow patterns in or adjacent to these areas.

There would be vegetation treatments and other activities that would change conditions within the Riparian Reserves as part of the proposed activities. This includes temporary road building and vegetation manipulation in order to create a diverse healthy riparian area while improving conditions and increasing tree size in surrounding stands. Riparian areas in the project area can be large at one to two site potential tees which depending on the resource being protected can be from 90 to 410 feet from each side of a stream. Within this area, Aquatic Conservation Strategies (USDA Forest Service and USDI Bureau of Land Management, 1994) as discussed in the Forest Plan Consistency section of this report, have been established to ensure positive trends in aquatic conditions and riparian dependent resources receive primary emphasis. As part of the ACS objectives, terrestrial ecosystem needs are recognized as riparian dependent and the riparian reserves can provide dispersal habitat for certain terrestrial species as discussed in the wildlife section. Impacts to Riparian Reserves from project activities analyzed here include:

System and Non-system roads pass through the Riparian Reserves throughout the watershed and while there would be road work completed on roads, as noted in the water quality and sediment discussion, construction and reconstruction of temporary roads would likely have the greatest impacts from road activities. Construction of 0.5 mile of new temporary road within the Riparian Reserves result in new ground disturbance, removal of vegetation over riparian dependent resources and up to 3 stream crossings. Note that while there are 3 stream crossings most of these are over ephemeral stream channels on alluvial fan settings that may not have passed water for several years. Installation of culverts in these locations ensures that in the case of a runoff event, the road is able to pass flows and not result in road failure, erosion and sedimentation.

Thinning activities would open up the canopy and bring in more light into Riparian Reserves by creating opportunity for natural recruitment of vegetation and understory release. This creates a multilevel forest structure that provides different ecosystem niches and opportunities for terrestrial and avian wildlife. Approximately 5,779 acres of thinning would occur in the Riparian Reserves with 3,607 acres occurring by mechanical thinning treatments and 2,172 acres of hand treatments. These thinning activities all have specific mitigation measures and best management practices that minimize adverse impacts to soils and from erosion that protect nearby aquatic resources. No cut buffers as discussed in the water quality section provide the necessary protection for maintaining the microclimate and stream temperature along stream corridors. Thinning would hopefully but not likely increase the angular insolation penetrating the dense stands over stream corridors and invigorate the growth and development of near channel riparian dependent vegetation such as hardwoods and stream bank vegetation (Press, 2014).

Alternatives 2A and 2B

These alternatives would not be significantly different from Alternative 2. These alternatives would still occur over the same foot print including the same riparian areas. The only difference in vegetative disturbance would a reduction in acres treated (307 acres less for Alternative 2A and 89 acres less for Alternative 2B). Therefore, effects to riparian reserves would be the same as those analyzed for Alternative 2.

Cumulative Effects

Table 9 outlines all of the past, present and future projects that could contribute cumulative effects within the Project area watershed. Since the project is not anticipated to have any effects to wetlands, there are no cumulative effects to consider in conjunction with past present and future projects in the project area watershed.

Many past projects have had influences on the distribution of and quality of Riparian Reserves and riparian dependent resources in the project area watershed and subwatersheds where work would occur. Past road building and development have degraded and altered riparian reserve function, distribution of wetlands, and opportunities for riparian dependent resources. Historic timber management has resulted in stands of dense homogenous regrowth in the Riparian Reserves that tend to lack the vegetative diversity, variable structure, and light necessary for a healthy functioning riparian ecosystem. Furthermore, there have likely been wetland losses across the project area and primary subwatersheds due to past road construction, as well as from past timber harvest activities. The amount of permanent wetland loss is unknown.

Recovery of vegetation and riparian habitat along road corridors that pass through riparian reserves is occurring through road decommissioning. Disturbances to the near channel riparian vegetation from road building and storage/decommissioning activities are also in a process of recovery.

There are no upcoming projects that would impact wetlands in the project area watershed, but some projects may alter Riparian Reserves. This includes future recreation projects that could create parking areas near the trailhead that are located within Riparian Reserves and adjacent to wetlands. While there would be a loss of Riparian Reserves, the effects of the project would be site specific and due to separation in space, would have no cumulative effects with the Riparian Reserves in the South Fork Stillaguamish Vegetation Project. Management of noxious weeds would potentially introduce herbicide and other chemicals to riparian reserves however the dictated types and means of application ultimately result in benefits to the integrity and assemblage of vegetation found within the Riparian Reserves.

Cumulative Effects Table

Table 9. Cumulative Effects table for hydrology

Project Activity	Type of Effect	Overlap		Cumulative Effect
		Time	Space	
Future Actions				

Project Activity	Type of Effect	Overlap		Cumulative Effect
		Time	Space	
Future Timber Harvest on Private and State Lands	Acres of disturbed soils, acres of disturbed vegetation.	Yes	Yes	Cumulative effect of vegetation disturbances take decades to recover. Effects would be additive
Gold Basin Sediment Reduction Project	Fine Sediment Reduction from Gold Basin Slide	Yes	Yes	The effects would be counteracting
Campground/Rental Maintenance – Hazard Tree Removal	Acres of Disturbed Vegetation	Yes	Yes	Cumulative effect of vegetation disturbances take decades to recover. Effects would be additive
ERFO Road Repairs	Miles of Roads Repaired	Yes	Yes	The effects would be counteracting
Mt. Loop Road Maintenance	Miles of Road Maintained	Yes	Yes	The effects would be counteracting

Project Activity	Type of Effect	Overlap		Cumulative Effect
		Time	Space	
Secondary Road and Trail Maintenance	Miles of road and trail maintained	Yes	Yes	The effects would be counteracting
Ice Caves Bridge Repair and Boardwalk Upgrade	Disturbed soils, improvement of wetland function	Yes	Yes	The effects would be counteracting
Camp Silverton Building removal and permit transfer to USFS	Acres of disturbed soils, removal of structures, restoration of disturbed area.	Yes	Yes	The effects would be counteracting
Present Actions				
Campground/Rental Maintenance – Hazard Tree Removal	Acres of disturbed soils, acres of disturbed vegetation.	Yes	Yes	Cumulative effect of vegetation disturbances. Effects would be additive
Mt. Loop Road Maintenance	Miles of road and trail maintained	Yes	Yes	The effects would be counteracting
Secondary Road Maintenance	Miles of road and trail maintained	Yes	Yes	The effects would be counteracting
Trail Maintenance	Miles of road and trail maintained	Yes	Yes	The effects would be counteracting
Invasive Plant Treatments	Acres of treatment	Yes	Yes	The effects would be counteracting
Non-Federal Land Timber Harvest	Acres of disturbed soils, acres of disturbed vegetation.	Yes	Yes	Cumulative effect of vegetation disturbances.

Project Activity	Type of Effect	Overlap		Cumulative Effect
		Time	Space	
				Effects would be additive
PAST ACTIONS				
Forest-wide invasive plant treatment	Acres of herbicide distribution	Yes	Yes	Cumulative effect is counteracting.
Waldheim Emergency Road Repairs	Acres of disturbed soils and vegetation removal	Yes	Yes	Effects would be additive
River Road Repairs	Miles of road and trail maintained	Yes	Yes	The effects would be counteracting
Waldheim Slide Repair Mitigation	Acres of restored land	Yes	Yes	The effects would be counteracting
Road, Trail, and Campground Maintenance	Miles of road and trail maintained	Yes	Yes	The effects would be counteracting
Invasive Plant Treatments	Acres of treatment	Yes	Yes	The effects would be counteracting
Red Bridge Campground Road Repair	Miles of road and trail maintained	Yes	Yes	The effects would be counteracting

Project Activity	Type of Effect	Overlap		Cumulative Effect
		Time	Space	
Timber Sale Activity in Canyon Creek	Acres of disturbed soils, acres of disturbed vegetation.	Yes	Yes	Cumulative effect of vegetation disturbances. Effects would be additive

10. Forest Plan Consistency

All alternatives within this project are consistent with the Mt. Baker-Snoqualmie National Forest Land and Resource Management Plan and FEIS, as amended, since all watershed standards and guidelines are met. In particular, this project would not exceed the 12 percent threshold of vegetation disturbance in any project subwatershed, thereby not creating excessive peak flow increases and the resultant channel morphology that would occur. State and Federal water quality standards would be met or exceeded through the use of Best Management Practices (mitigation measures) and any applicable permitting from State and Federal agencies. Riparian areas would also be accelerated toward the desired future condition of improved habitat diversity through mature tree management while maintaining trees needed for slope stability and future large woody debris recruitment into stream systems. All alternatives are consistent with the Aquatic Conservation Strategy Objectives (see consistence analysis below).

Aquatic Conservation Strategy

The Aquatic Conservation Strategy is a primary component of the Forest Plan, as amended, and is intended to maintain and restore ecosystem health, preventing further degradation and restoring habitat over broad landscapes instead of small watersheds or individual projects (USDA Forest Service and USDI Bureau of Land Management, 1994). This would protect aquatic and riparian-dependent species and resources, and restore degraded habitats. The following is a brief description of how the South Fork Stillaguamish River Vegetation Project relates to each objective.

<u>Objective 1</u>: Maintain and restore the distribution, diversity, and complexity of watershed and landscape-scale features to ensure protection of the aquatic systems to which species, populations and communities are uniquely adapted.

Proposed project activities would treat forest stands throughout the South Fork Stillaguamish River watershed. Silvicultural treatments in Riparian Reserves would increase diversity of stand composition and structure, while no-cut riparian buffers would maintain riparian functions of

shade cover, sediment and nutrient filtering, bank protection and large wood recruitment. Performing on-the-ground treatments on 103 miles of existing system roads and 23.4 miles of nonsystem roads, plus decommissioning 14 miles afterwards would incrementally help to restore the effects roads have had on this part of the watershed, which included increasing the drainage network and disrupting proper routing of sediments and woody debris to the river. Project activities would incrementally help to restore this objective at the watershed scale.

Objective 2: Maintain and restore spatial and temporal connectivity within and between watersheds. Lateral, longitudinal, and drainage network connections include floodplains, wetlands, upslope areas, headwater tributaries, and intact refugia. These network connections must provide chemically and physically unobstructed routes to areas critical for fulfilling life history requirements of aquatic and riparian-dependent species.

The no-cut buffers along all streams and wet areas would maintain connectivity of riparian habitats. Reconstruction on system roads would improve connectivity by adding drainage culverts to more effectively pass water under these road beds. While the drainage network would be increased as new temporary access routes are constructed, temporary routes on non-system roads would be obliterated. Project activities would have both a positive and negative effect on connectivity at the site scale in the short term during project implementation, with a net incremental benefit at the site scale. Project activities would maintain this objective at the watershed scale.

Objective 3: Maintain and restore the physical integrity of the aquatic system, including shorelines, banks, and bottom configurations.

No-cut buffers and other mitigation measures and BMPs would maintain banks, bottoms and shorelines primarily through avoidance from activities associated with timber harvest. On nonsystem temporary roads culverts would be installed and removed after use. Additionally, proposed action would decommission and/or obliterate 14 miles of road. Removing culverts and pulling back the approach fills to more closely match the natural channel dimensions would locally restore channel beds and banks at these locations. The project would incrementally restore this objective at the site scale, and maintain it at the watershed scale.

Objective 4: Maintain and restore water quality necessary to support healthy riparian, aquatic, and wetland ecosystems. Water quality must remain within the range that maintains the biological, physical, and chemical integrity of the system and benefits survival, growth, reproduction, and migration of individuals composing aquatic and riparian communities.

Implementing no-cut buffers and other mitigation measures and BMPs, and abiding by provisions of the hydraulic and other permits would minimize the potential for project-related contaminants and sediments to reach streams, and are expected to result in no measurable effects to water quality. While there could be some sedimentation associated with working in the channel/rewatering the channel, it would be short-term, during project activities, and also occurring during non-spawning periods in streams that do not have fish or are nonfish-bearing at the site. Where herbicides would be used to treat invasive plants near water, special treatment

prescriptions per the 2015 Weeds EIS would protect aquatic resources. The project would maintain this objective at the site and watershed scale.

Objective 5: Maintain and restore the sediment regime under which aquatic ecosystems evolved. Elements of the sediment regime include the timing, volume, rate, and character of sediment input, storage, and transport.

Implementing no-cut buffers and other mitigation measures and BMPs would minimize potential effects to the sediment regime from timber harvest and road activities. Project-related sedimentation to streams could occur during implementation and after the first few flushing flows. Road treatments would result in an overall decrease in the risk of sedimentation from surface runoff and mass wasting, which would improve the sediment regime in the long-term. Overall, project activities would help to restore this objective at the site scale, but maintain it at the watershed scale.

Objective 6: Maintain and restore in-stream flows sufficient to create and sustain riparian, aquatic, and wetland habitats and to retain patterns of sediment, nutrient, and wood routing. The timing, magnitude, duration, and spatial distribution of peak, high, and low flows must be protected.

Through interdisciplinary project development, along with no-cut riparian buffers and other mitigation measures, project activities would maintain flows and patterns of sediment, nutrient and wood routing. With the proposed action, removing additional culverts and decreasing the drainage network along 14 miles to a more natural pattern would incrementally improve hydrologic integrity and timing and quantity of instream flow patterns in the South Fork Stillaguamish River watershed and improve routing of wood and sediments, though likely not in a measurable way. Project activities would maintain this objective at the site and watershed scales.

Objective 7: Maintain and restore the timing, variability, and duration of floodplain inundation and water table elevation in meadows and wetlands.

Wet areas were surveyed and mapped. Through interdisciplinary project development, along with no-cut riparian buffers and other mitigation measures, project activities are not expected to affect floodplains, or water tables in meadows or wetlands. The project would maintain this objective at the site and watershed scales.

Objective 8: Maintain and restore the species composition and structural diversity of plant communities in riparian areas and wetlands to provide adequate summer and winter thermal regulation, nutrient filtering, appropriate rates of surface erosion, bank erosion, and channel migration and to supply amounts and distributions of coarse woody debris sufficient to sustain physical complexity and stability.

Riparian areas, including wetlands, would have no-cut buffers that would maintain existing functions. Silvicultural treatments in Riparian Reserves are proposed (e.g., thinnings) to increase the species composition and diversity of plant communities. Proposed thinnings would accelerate development of large trees that become woody debris of sufficient size to provide channel stability and create long-term instream habitat features such as deep pools. Openings in Riparian

Reserves would be planted to increase species and structural diversity of riparian forests. Project activities would incrementally help to restore this objective at the site and watershed scales.

Objective 9: Maintain and restore habitat to support well-distributed populations of native plant, invertebrate and vertebrate riparian-dependent species.

All riparian areas would have no-cut buffers that would maintain existing functions and a microclimate supportive of species that are sensitive to changes in temperature and humidity such as amphibians, mosses, mollusks, and certain types of vegetation. These conditions would provide for low mobility species associated with riparian habitats to use these areas for dispersal. Mitigation measures would address invasive vegetation. Silvicultural treatments in Riparian Reserves are proposed (e.g., thinnings) to increase species diversity and stand age and canopy structure to create a diverse range of habitats to support a variety of species within the Riparian Reserves and across the landscape. Project activities would incrementally help to restore this objective at the site and watershed scales.

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